TRAFFIC QUARTERLY

AN INDEPENDENT JOURNAL FOR BETTER TRAFFIC

OCTOBER 1949

Truck Traffic
Metropolitan Planning
One-Way Street Case Study
Can We Afford More Accidents?
Dollar Signs in Highway Planning
Pittsburgh's Better Traffic Program
Why Parkers Select Garages or Lots
Traffic Engineering as a Profession
Accidents, Car Cost and Insurance
Radio in Highway Communication
Suburban Shopping Center

THE ENO FOUNDATION FOR HIGHWAY TRAFFIC CONTROL

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Traffic Quarterly

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An Editorial

YOUTH as a group are bad drivers. Individuals among them are skillful, responsible, safe. But statistically, the accident record is far out of line for the driving they do. Mile for mile, their elders turn in a better score.

Yet youth could excel in driving as in athletics. Young eyes are keener, young minds quicker. Young hands are firmer, more responsive. Youth's stamina slumps less easily under strain. Born in a mechanized age, maturing in an atmosphere of social responsibility, youth as drivers could set an example for their elders who grow gradually slower in mind and body.

What youth lack apparently—and not all of them do lack it—is disciplined judgment, an adequate sense of caution. Many lack the habit of considering consequences in impulsive speeds, dangerous passing, and other acts of careless daring.

Improvement may lie partly in the hands of elders, partly in the hands of youth. We give youth increasingly powerful cars and the increasing responsibility for them. Perhaps beforehand, and constantly thereafter, we should more carefully inculcate the *sense* of responsibility, the *habit* of caution, the *constituents* of judgment. Perhaps we should scrutinize skills and attitudes more carefully before issuing permits to *all* age groups. And doubtless youth should take stock of their unrealized possibilities and of consequent public concern.

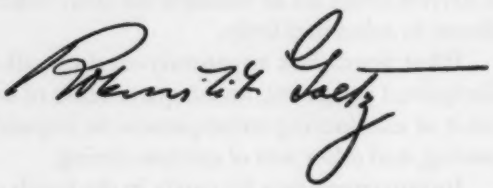
Youth are frequently maligned because elders have grown more conservative—and more distorted in remembering how well they solved problems of their own youth. Youth still have problems, no fewer and no simpler than problems of their parents' youth. And youth inspire us with their emulation of sound values of the past, and with their grasp of opportunity with which to meet the future. It is their failure—and in part, ours—to use more rationally their greater advantages and greater freedom that leads too large a proportion of them into serious pitfalls—the more serious as the power of our motor-driven age increases. When youth's misbehavior extends to appreciable numbers, all youth unfortunately are tarred with the

same brush of discredit. Individually, the worst of them jeopardize the valuable privilege of all.

Authorities are aroused by youthful drivers' recklessness, by the gruesome character of the accidents. To continue the record may force further restriction, even denial, of the privilege youth plainly enjoy.

Progress is being made in educational efforts to teach youth the seriousness of driving responsibility, of obligations on the highway, and the fateful consequences of bad driving.

More effort, more progress are manifestly needed—by youth and their elders alike.



Pittsburgh's Better Traffic Program

MAYOR DAVID L. LAWRENCE

Mayor Lawrence is the leader in a program of community improvement for the Pittsburgh district, hailed nationally as the most far-reaching city program in the country. It includes the elimination of smoke, the purification of rivers, urban redevelopment, low-rent public housing, a limited access parkway system, new financing for city government, a wide expansion of municipal park and recreation facilities, and an extensive interest in the traffic safety movement. Pittsburgh, the first major city to hold a Mayor's Highway Safety Conference as requested by President Truman in 1946, has made the Conference an annual affair since that time, holding the fourth one last June. Mayor Lawrence has served as Democratic County Chairman, Democratic State Chairman, Collector of Internal Revenue, and Secretary of the Commonwealth of Pennsylvania. He is president of the Harris-Lawrence Company in Pittsburgh.

CARDINAL NEWMAN in his "Christian Doctrine" remarked: "To live is to change, and to be perfect is to have changed often." This is particularly true when you relate it to the development of a traffic-safety program.

No city in the United States today has *solved* the traffic problem. Pittsburgh is no exception. We do feel, however, that if rapid strides are to be made, they must be made on a cooperative basis. It is a job for both city and surrounding boroughs and townships to accomplish by expanding effective city projects into the outlying areas.

There are no hard and fast rules for a successful program. The problem is to change and adapt the project to fit needs of the moment. The more constructive the changes, the more nearly perfect the program that will be achieved.

We in the cities must struggle with the humdrum things of daily living—one of which is the elementary necessity of preventing traffic injuries and death in our swarm of moving traffic.

Nearly one hundred people a year are killed on the streets of Pittsburgh. If they met their deaths in one sudden catastrophe, a whole nation would be horrified. As it is, we tend to take it as a

matter of course—a regrettable, but seemingly inescapable phase of modern machine-age life.

But have we any right to take these deaths for granted? When I became Mayor of Pittsburgh, I enlisted with those engaged in fighting against traffic casualty. We determined that every bit of the city's energy and resourcefulness should be thrown into the battle for traffic safety, to cut down accidents, to eliminate traffic deaths.

No one can rightly estimate our success or failure. We cannot know what the accident rate, and the death rate, would be if we relaxed our efforts. We only know that we have a solemn duty to keep trying. That is what all of us must do.

Essentially a Regional Job

I have a deep conviction that the work of traffic safety must be basically a *local* job—that the Federal Government can help, that the states can help, but that the real work—the operating work—must be done in the municipality.

In Allegheny County, which contains Pittsburgh, there are almost 1,500,000 people. Half of them live in the city proper. The others live in 128 independent municipalities, each with its own police force, its own magistrates or justices of the peace, its own traffic control system, and its own way of doing things.

We have a city police force, a county police force, a state highway patrol, and scores of separate police agencies distributed among the independent municipalities.

With us, it must be cooperation or chaos.

In the work of traffic safety, we have pitched our whole program to inter-municipal cooperation.

In all our relations with our suburban communities, we employ the Good Neighborhood Policy. We never attempt, through use of a possibly superior economic or political power, to apply anything that looks like the Big Stick.

Since our traffic safety program went into high gear, there has never been a doubt in our minds that its success depends as much upon our neighbors as upon ourselves. Figures prove that.

Thirty per cent of the drivers involved in accidents on the streets

of Pittsburgh, for example, are not our own residents; they live in adjoining municipalities. Last year in Pittsburgh, there were 84 traffic deaths. But in the county area *outside Pittsburgh,* with the same population as our own, there were 212 fatal driving accidents—more than twice as many as occurred within the city limits. These facts exemplify the need for a regional program.

With that knowledge, we have proceeded on a "One for All and All for One" safety program in our Pittsburgh district.

Invitations to the Mayor's Annual Highway Safety Conference go to municipal officials throughout the County. These officials are asked to bring their most active civic leaders. The conferences draw an attendance that goes up to 1,800 persons. At least half of the delegates are not residents of the City of Pittsburgh.

Membership on our own Better Traffic Committee—our advisory citizens' group on traffic problems—is not restricted to Pittsburgh residents.

Traffic Schools for Police and Private Drivers

The Police Training Academy, with its many courses in traffic control and traffic safety, is open to the police officers of our surrounding boroughs and townships.

Our Traffic Safety School, where any citizen can be taught the fundamentals of safe driving, welcomes any Allegheny County driver.

We had remarkable success in Pittsburgh with the school safety program known as the Green Pennant Campaign. It was sponsored by the city with the aid of the Pittsburgh *Sun-Telegraph,* and it provided the means for a new emphasis on traffic safety in our schools. In its first year of operation, we were able to show the lowest child fatality record in the city's modern history—only one child of school age killed in traffic.

That program we have now extended to every elementary school in Allegheny County.

Our traffic bureau has been rightly concerned with the high percentage of trucks involved in accidents.

To help meet this problem of the commercial driver, it arranged for two Commercial Drivers' Conferences to be held during 1948.

Labor, management, and the city administration worked together to set up these conferences, which were attended by 4,700 drivers. No one thought for a minute that we should concern ourselves only with drivers who lived in Pittsburgh. The conferences were wide open.

Procedures for Safer Driving

With the help of the Western Pennsylvania Chiefs of Police Association, we are getting increasing unity of effort by law enforcement officers. Their efforts at cooperation were tested recently by a roadblock established on the county's main and secondary highways. Between midnight and five in the morning, 600 police officers were stationed at strategic highway points, checking 50,000 motorists for owners' and operators' cards. Similar tests, sprung without advance warning, will be held from time to time, serving notice that the police —all the police in the county—mean to curb illegal and drunken driving.

It is our fixed policy to use every agency we can—public or private —in the city or in the county area—to promote the cause of safer driving.

The city administration joined the county government and civic planning bodies in sponsoring a legislative program at the 1947 Legislative session which rapidly was tagged as "The Pittsburgh Package." One of the items in that legislative package was the creation of a county-wide traffic and transit commission.

That commission is now functioning.

We think it will have a useful life, if it pursues its creators' purpose of studying mass transportation and of rendering service to those communities outside the city which do not have professional traffic planning staffs.

It must be careful, as the city government has been, to put its effort forward through the practice of *co-operation*. Attempts at domination are fatal when the goal is unified action among independent municipalities.

The measure of our success will be the voluntary help we can attract; the extent to which we can arouse community feeling regardless of the boundary lines of municipal subdivisions.

That we must do by example, as well as by precept.

In seeking to stimulate safety efforts in our surrounding communities, we must be sure that we ourselves are doing everything that lies within our power.

We have therefore continued and intensified our well-established programs in traffic safety education and in traffic planning engineering.

We found weaknesses in our enforcement structure. Those weaknesses we are working always to correct.

Pittsburgh's Police Procedure

In a democratic society, law enforcement is as rigorous and impartial as the people themselves want it to be. We quickly found that to enforce the traffic laws, we needed public support. We found that we had to make it "smart" to obey. We had to root out the idea that only timid souls waited for a light to change, or did not try to fix a traffic ticket. We set out to sell—if you will—the merits of strict traffic law enforcement to the people of the community. We continue to put our most solid emphasis behind enforcement because our investigations show us that seven out of every ten accidents are caused by a driver's violation of a rule of the road.

This invigorated enforcement drive has meant some sweeping changes in our police affairs, and in our traffic court administration.

We have trained 180 women to act as school-crossing guards, thereby relieving many police officers who formerly worked such details. Fifty of these released officers have been added to the Traffic Division. Policing of our metered zones has been stepped up. Our motorcycle squad has been given 22 new men, and two new lieutenants.

The whole police force has been indoctrinated in traffic safety. Its entire personnel attended a two-day safety conference. For six consecutive pay periods, the patrolmen's pay envelope contained a message from the Mayor on traffic safety and law enforcement.

During 1948, Pittsburgh police made 28,806 arrests for moving violations— *a fifty per cent increase* above the record of the previous year. Traffic Court, its system strengthened by additional personnel

and modern business record-keeping machines, found reason to convict 87 per cent of the defendants heard.

We do not think that Pittsburgh drivers have become more reckless. We *are* sure that Pittsburgh police have become more vigilant.

Municipal Effort Affects Entire Region

We are firmly convinced that a good enforcement program in Pittsburgh has beneficial effects on drivers throughout our entire metropolitan area. We are equally sure the effect will be felt in reverse.

Accordingly, we say to our neighbors in the boroughs and townships: "Go ye, and do likewise."

Certainly, the many city-sponsored safety programs on Pittsburgh radio stations have their effect in a wider area than our own municipal boundaries.

In almost the same manner, the effects of good traffic law enforcement spread through the whole community, whether we plan it that way or not. Safety cannot be divided between the city and its suburbs. Good driving habits are not turned off or on at a political boundary line. This is an area job, and we have so approached it.

Of course, we seek the support of our superior unit of government—the state.

It is fortunate for the Pittsburgh district that the governor recognizes the urgency of our traffic needs. The state administration is cooperating fully with the county and city governments in building a new network of limited access highways to serve the Pittsburgh district. Federal funds, distributed through the Public Roads Administration, are channeled into the program.

We are working in complete harmony—so that we can solve the structural problems, so we can build a twentieth century highway system that will move traffic swiftly and safely.

We are sure that the same state cooperation that has helped us so much in highway construction will be extended to the operation of those highways, to their policing, to their safety standards, to the individual driver's habit of obedience to law.

The Governor's Highway Safety Committee is now set up on a regional basis. We shall cooperate fully with it. We shall trust to it

the task of intensifying the area program in a manner that we, as an independent city, cannot always do with our equally independent neighbors.

City Service Can Be Great

I observed that municipal administration is the humdrum, dull, work-a-day branch of government. On the surface, that is true. In many peoples' minds, it has no capacity to kindle the emotions, to stir men's thinking, to lift up the spirit.

Yet this negative quality need not obtain. There is a spark in good city government, and we can fan it to flame. *Civic pride, community loyalty, citizenship*—these are moving things. They can stir men and women to great achievement.

We who are in municipal administration fail in our duties if we cannot bring the vision of community effort and community success to the hearts and minds of our people.

There are a score of fields for finely dedicated citizenship. Public health, slum clearance, city beautification, the elimination of air pollution—the list is long.

But none of them is more important than traffic safety. There, the stake is life itself. We must always remember that there is no better objective than the work of mercy—the saving of a human life. No rule for success will work—if *you* won't.

Problems and Advantages of Radio In Highway Maintenance Efficiency

WARREN K. MYERS

Mr. Myers is the Chief Maintenance Engineer of the Pennsylvania Department of Highways. He started with the Pennsylvania Department of Highways in 1923, has filled various positions in the Construction Unit from Assistant Inspector to District Engineer. Has also filled all positions in the Maintenance Unit from Assistant Maintenance Superintendent to Chief Maintenance Engineer. He was appointed Chief Maintenance Engineer in 1943. Mr. Myers is Chairman of the American Association of the State Highway Officials Committee on "The Use of Radio in Highway Departments."

AT ONE time, the state highway systems consisted of roads connecting centers of population. This was adequate until travel by automobile and the handling of freight by trucks were expanded. Today a state highway system must be a complete transportation system coordinated with other transportation systems such as rail, water and air facilities. Many communities have no means of transportation other than by automobile, bus or truck, and if denied these methods they would be completely isolated. In 1948, trucks handled half of all of the freight tonnage hauled in tthe United States, and travel by automobile had increased from 55 billion miles in 1921 to 395 billion miles.

The operation of such a transportation system presented many problems not present in normal business operation. A state highway system cannot be operated in one plant; it is distributed over a wide area. To furnish the proper supervision over such an operation requires that those in charge be in contact with the various operations at all times. This demands an adequate communication system. The present wired services available to highway departments were adequate at one time; today, however, with the volumes of traffic

using our highways and the multiplicity of problems encountered, these wired facilities are not adequate. The only adequate communication system is radio.

As early as 1938, highway departments started using radio. California and Washington were among the first to install it. At that time only one usable frequency was assigned for the use of state, county and municipal highway departments. Originally, the use of radio by highway departments was classified as an emergency service and could be used only for that purpose. With the expanded use of radio, interference and operational difficulties soon developed. By 1945, the facilities available had proved entirely inadequate.

There are now 327,000 highway maintenance employes of the state, county and municipal highway departments spread out through the United States preserving and operating the 30-billion-dollar public investment in highway facilities for the safe use of the owners of 41 million registered motor vehicles.

These highway employes are working strenuously to decrease the accidents on the highways. In one year, 1947, there were over a million personal injuries and 32,300 deaths on the highways due to motor vehicle accidents. Highway maintenance forces of states, counties and municipalities have at their disposal about 300,000 major mechanized equipment units with which to work towards decreasing these accidents, especially in the prompt treatment of ice-covered pavements, clearing of snow-covered highways, proper signing of hazardous areas, the removal of trees and live wires blocking the highway, prompt patching of pavement and hazardous shoulders, and many other tasks that are daily duties of highway employes, too extensive to enumerate. They take an important part in alleviating the road conditions that result from floods, slides, hurricanes, tornadoes, and other types of disaster.

Highway maintenance departments are going organizations that possess some 300,000 pieces of mechanized equipment—trucks, bulldozers, motor graders, power shovels and other units adaptable to the work described. These state, county and municipal highway organizations are on call under the control of public officials and ready for any emergency to which they may be assigned.

Radio Interference Problems

Until recently, the state, county and municipal highway departments had assigned to them only one usable radio frequency, 37.98 megacycles, for use in their work and subject to sharing by forty-eight states, over 3000 counties, and over 2000 municipalities having a population of five thousand or more. Considerable interference was experienced in the use of this one frequency. Onondaga County, New York, operating on this frequency, received interference from the Washington State Highway Department and vice versa.

Similar conditions of interference exist between other highway departments.

It was soon recognized that individual action in the various state, county and municipal highway departments would not produce a plan for a usable radio communication system. In 1945, the American Association of State Highway Officials—membership consists of the officials of the forty-eight state highway departments, the two territorial highway departments of Puerto Rico and Hawaii, the District of Columbia and the U. S. Public Roads Administration—established a committee on the use of radio in highway departments to represent the interests of its members in obtaining the important means of communication made available by the use of radio facilities.

The object of this committee is to assist state, county and local highway departments in obtaining sufficient frequencies for the necessary operation of radio in connection with highway work; to recommend the assignment of frequencies so that maximum communication results will be obtained with a minimum of interference; and to accumulate and distribute data regarding advancements and procedure in the efficient operation of radio in connection with highway work. This committee was designated to represent the interests of highway departments in the above subject matter before the Federal Communications Commission.

Demands upon the committee on the use of radio, including such items as availability of frequencies, interference in the use of radio frequencies allocated to highway departments, information concerning availability of equipment, costs of installation, and other pertinent items, are becoming increasingly more frequent. These

demands indicated the increased interest in radio services and foreshadowed a critical situation in the use of radio by highway departments.

Making Highway Radio More Efficient

Up until the time that this committee was organized the Federal Communications Commission had not given recognition to the relative essentiality of highway department activities. Radio frequencies were not reserved for the exclusive use of highway departments. The permissible use of radiotelephone was then on a restricted special emergency basis that did not economically justify investment in equipment except in a few states having severe snow and ice conditions.

The Federal Communications Commission generally gave weight to testimony furnished at its hearings by committees representative of an entire industry or group seeking radio frequencies, especially if such committees could obtain understandings within the group that would assure the proper use of radio and would avoid abuses within the industry. Such committees were most effective in producing facts that disclosed the relative essentiality of their needs for radiotelephone. The power and transit utilities, railroads, police and fire departments, forest conservation groups, bus and truck associations and others who had committees functioning, were successful in obtaining radio frequencies for their groups.

One of the early functions of the A.A.S.H.O. Committee on the Use of Radio in Highway Departments was, therefore, to present facts regarding present and future needs of the highway departments for radiotelephone at the various F. C. C. hearings, and before the Interstate Commerce Committee of the U. S. House of Representatives. As a result of these proceedings, the F. C. C. issued a proposed revision of rules under Docket 9001.

On April 27, 1949, the Federal Communications Commission approved Docket 9001 containing the revision of Part 10, "Rules and Regulations Governing Public Safety Radio Services," effective July 1, 1949, which provides 14 additional frequencies reserved primarily for assignment to highway maintenance systems operated by states.

The use of this frequency by other highway maintenance licensees will be authorized only where the use is necessary to coordinate activities with the particular state to which the frequency is assigned. Any request for such use must be supported by a statement from the state concerned. Six additional frequencies are available on the basis that they will be shared with the Special Emergency Radio Service. Other frequencies are available for development operations or on a shared basis where interference to television stations and maritime mobile service will not result.

Authorization for stations in the highway maintenance service will be issued only to states, territories, possessions and other governmental subdivisions, including counties, cities, towns and similar governmental entities.

Stations in the highway maintenance radio service are authorized to transmit:

(a) Communications directly relating to Public Safety and the protection of life or property;

(b) Communications essential to official activities directly relating to the maintenance, supervision and operation of public highways.

Highway maintenance fixed stations are primarily authorized to intercommunicate with highway maintenance mobile stations. Highway maintenance mobile stations are primarily authorized to intercommunicate with base and other highway maintenance mobile stations.

Highway maintenance fixed and mobile stations are secondarily authorized to intercommunicate with other stations in the Public Radio Services and to transmit to receivers at fixed locations, provided that no harmful interference will be caused to the service of any station transmitting to a point of communication for which that station is primarily authorized.

Highway maintenance fixed stations may intercommunicate with other fixed stations in the Public Radio Services and transmit to receivers at fixed locations.

Generally, highway maintenance radio service will be authorized on frequencies 46.86 mc. to 47.38 mc.

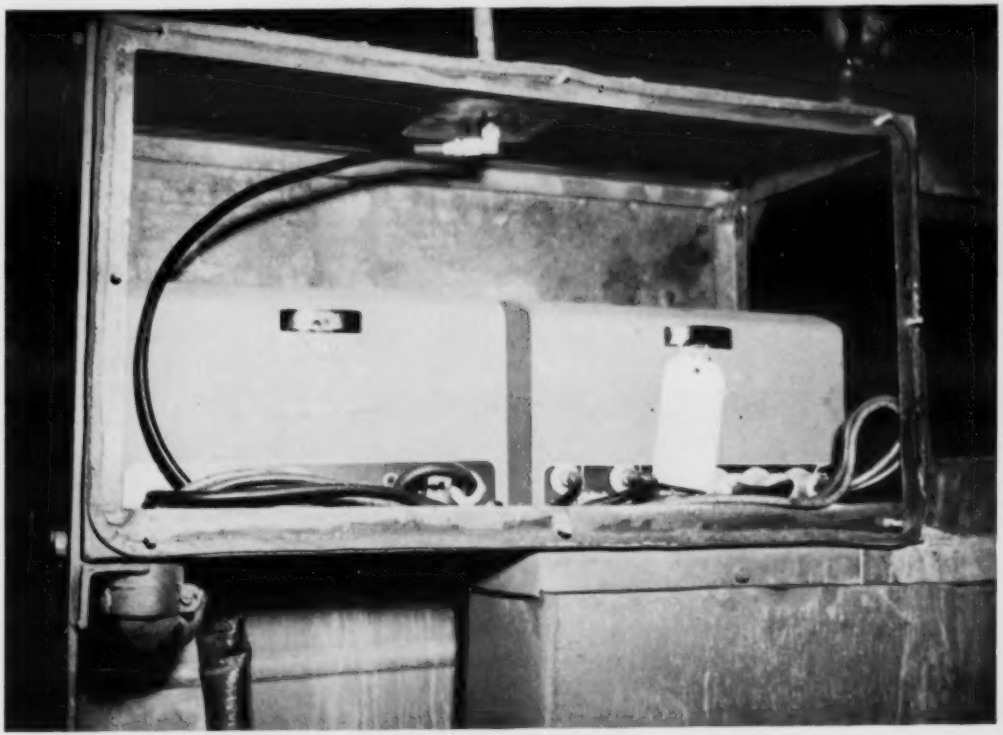


FIGURE 1. Installation on truck

FIGURE 2. Installation on truck showing antennae and hand-set

Frequency Allocation is Being Studied

The Federal Communications Commission has indicated a desire to obtain agreement among the highway group as to how the frequencies available can be most fully utilized in the public interest and on a non-interference basis. Sky wave interference has been experienced between East and West coast stations that illustrates the need for a national assignment pattern in connection with the use of the frequencies now available. It has been suggested that highway departments develop a national assignment pattern for the use of these frequencies. The Committee on the Use of Radio in Highway Departments, A.A.S.H.O., is developing an allocation plan for the assignment of frequencies that will be submitted to the Federal Communications Commission.

When this allocation plan is completed and accepted by the F.C.C. the A.A.S.H.O. Committee on the Use of Radio will be asked to make recommendations to the F.C.C. regarding applications for radio communications facilities. These recommendations are to be submitted in the form of a statement commenting upon the frequency requested, and giving an opinion regarding the possible interference to existing stations and the effect of channel-loading that might result from a grant of the requested facilities.

The F.C.C. has requested that "The frequency advisory committee be so organized that it will be representative of all persons involved who are eligible for radio facilities in the service concerned in the area the committee purports to represent and for which recommendations are made. The functions of these committees will be purely advisory; their comments and recommendations will not bind the Commission.

All radio stations, both fixed and mobile, must be authorized by the Federal Communications Commission. Station licenses may be obtained upon proper application to the Federal Communications Commission. Necessary forms may be obtained from the office of the commission at Washington, D. C., or from any of its field offices. Each application for an authorization in highway radio maintenance service shall contain full and complete information as to all matters and things required to be disclosed by the application forms. These

applications must be filed in duplicate with theFederal Communications Commission at Washington, D. C., at least sixty days before the contemplated installation or removal.

Separate applications for construction permits are to be submitted for each station to be located at a fixed point. Applications for construction permits for mobile stations may be submitted for any number of mobile units on the same form.

In circumstances requiring the immediate use of radio facilities a request may be made for special temporary authority to install and operate new equipment or to operate licensed equipment in a manner different from that authorized in the station license. Requests for special temporary authority must be received by the Commission at least ten days before the date of the proposed operation.

The issuance of the revised rules for the use of radio by highway departments recited above removed this service from the emergency classification and placed it in the Public Safety classification, thus making a practical communication system for use in connection with the maintenance and operation of highway transportation systems.

To date this service has been used for the following operations:

1. Dispatching equipment for snow removal operations.
2. Dispatching equipment and ordering materials for the treatment of ice-coated roads.
3. Communications from mobile equipment to central office regarding road conditions for the purpose of diverting traffic until snow is removed and ice-coated roads are made safe through treatment with abrasives.
4. Reporting breakdown of snow removal and ice treatment equipment, snow blocked travelers and needed relief in accidents on slippery pavements.
5. Communications from mobile road maintenance equipment to central or district office regarding newly posted load limitations during spring thaw for prompt relay to motor carriers so that they may readjust their loads before leaving freight terminals.
6. Communications regarding needed surface repairs or broken pavements where there is imminent danger of causing traffic accidents.
7. Highway floods and washouts.
8. Slides blocking the traveled surface.
9. Fallen trees and live electric wires blocking highway.
10. Low shoulders adjacent to narrow pavement endangering traffic.
11. Loose floor planks in bridge and other needed bridge repairs which may damage vehicles.

12. Broken guard rail which protects safety of traveling public.

13. Broken stop signs or other traffic control devices at intersecting grades, grade crossings and other areas where failure may cause traffic accidents.

14. Control of detours around construction projects or other obstructions.

15. State force account work in rural areas where bituminous operations must be coordinated with central mixing plant.

16. Repairing or cleaning of blocked culverts and drainage channels during storms to prevent excessive erosions or flooding of highway surface.

17. Communications regarding the measurement and marking of sight distance during center line marking operations; and to prevent motorists from crossing wet painted lines.

18. Ordering road supplies and food for highway maintenance camps in remote areas.

19. General communications regarding the dispatching of equipment and ordering maintenance materials from along the highways to improve management, cut down dead haul and decrease the number of equipment units which various Government agencies would have to buy and keep in operation.

20. For communications in the erection of bridges and structures and as a State highway department aid to construction contractors in isolated areas.

21. As an aid to survey parties.

22. Communications regarding general accidents on the highways and first-aid needs.

23. Experimenting with signals and warnings to motorists at dangerous grade crossings, road intersections, sharp curves and no-passing zones where the sight distance is inadequate.

24. Transmission of daily road reports to district and main headquarters.

The efficiency of radio depends entirely on its proper use. Messages should be short and to the point. The following are standard code signals that are used. The numerals are used to convey certain messages:

10–1	Receiving poorly
10–2	Receiving well
10–4	O.K.
10–5	Relay
10–6	Busy
10–7	Out of service
10–8	In service
10–9	Repeat, conditions bad
10–13	Advise weather and road conditions
10–18	Complete present assignment as quickly as possible
10–19	Return to your station

10–20 What is your location?
10–21 Call this station by telephone
10–36 Correct time
10–68 Repeat dispatch
10–99 Unable to receive your signals

Instructions should be given all employes using radio to make each communication as short as possible.

Radio Experience Reports from Three States

Reports on the use of radio by state highway departments have been received from California, Washington and Pennsylvania and from the County Highway Department of Onondaga County, New York.

California in 1948 had twenty-seven land or fixed stations and fifty mobile units. Because of the fact that until 1947 stations were licensed as special emergency, which restricted their use to strict emergencies and non-existence of disruption of other means of existing communication, this system was built around the heavy-snow areas rather than a completely coordinated radio system.

The use of radio communication by this highway department increased materially immediately upon broadening of the license to Highway Maintenance. Under the Special Emergency license, radio was mainly used in connection with snow removal operations. With the broadened license, however, radio is now being used in connection with normal highway operations such as patching, oiling, and sealing work. Instead of being limited to use in the winter season, it is now being utilized on a yearly basis.

The original mobile installations, because of license restriction, were in the heavy snow equipment with some sets in superintendents' cars or foremen's pick-up trucks operating in the heavy-snow areas. Future mobile installations will now be made on all types of highway maintenance equipment wherever it is felt mobile communication is needed in normal maintenance activities.

The future plans in this state call for no major expansion of their present system beyond the proposed installation of an additional district. Their efforts will now be directed towards planning and installing an ultra-high frequency radio system, possibly in the 152–162 megacycle band, to insure a positive all-year communication

FIGURE 3. Hand-set in use

FIGURE 4. Installation of equipment in personnel automobile

system free from atmospheric disturbances and skip interferences so prevalent on the lower frequencies.

Washington now has one of the most modern and comprehensive highway radiotelephone systems and is working continuously to make this communication system work more efficiently by the installation of additional facilities.

Much of the highway mileage in this state is scenic, transporting the motorist through dense forests of Douglas fir and pine; leading him, too, into the Cascade Mountains where he can see such natural wonders as Mount Ranier, Mount St. Helens and Glacier Park.

Easy and safe access to Washington's rugged beauty requires a never ending maintenance program in mountainous areas where weather changes occur, and with little or no warning rock and snow slides can imperil the safety of motorists. On February 2, 1947, for example, a snow slide might have exacted a grim toll of human suffering had it not been for the speedy intervention of a two-way radiotelephone. Forty people in twenty-five passenger cars and one bus suddenly found themselves trapped in a two-and-a-half mile canyon of snow on Stevens Pass, when tons of snow slid from steep mountainsides, blocking both avenues of escape. Present, however, was a highway foreman who lost no time using the two-way radiotelephone mobile unit on his pickup truck. Soon the Ski Patrol was on its way with food and necessary supplies. Morale, which might have been desperately low under other circumstances, was high because the group could use the radio to relieve anxious relatives of any fears regarding their safety.

Though many of the radio system's uses are of a dramatic nature, the main function of communication operations is to expedite the innumerable run-of-the-mill tasks typical of any highway maintenance department.

Washington State Director of Highways Shain stated that, "It is difficult to make an estimate of the actual saving of time or of dollars and cents through the use of a 2-way FM radiotelephone. However, radio does enable the Department of Highways to give a much faster and better service to the travelling public."

Pennsylvania is now operating its radio communication system for the third year. Experimental installations were made in 1947, and this service was expanded in 1948. The radio was installed in areas

where the most difficulty with snow and ice is encountered. Use of radio communications has permitted the Pennsylvania Department of Highways to operate their snow removal service on a district basis rather than a county basis, as was done previously. This will eventually reduce the amount of equipment required and permit better coordination of snow removal activities. Radiotelephone has also proved to be valuable in connection with general maintenance operations and emergencies generally encountered in the operation of the highway system. With additional frequencies available which will eliminate the interference previously encountered, the Pennsylvania Department of Highways intends to expand its radio facilities.

Report From Onondaga County, New York

Onondaga County, New York, has installed a radio communication system, which, according to Ray B. Traver, County Superintendent of Highways, has proved of inestimable value in connection with operating their highway system. Mr. Traver states that "the feeling of security and readiness that the use of a radio communication system imparts to the head of a highway department and the supervisory force is hard to explain. The knowledge that not a man or a piece of equipment is any farther away than the microphone on the desk or the dash of the supervisor's automobile is responsible for this feeling. We feel that the installation of a radio system has paid for itself in less than a year of operation, and we earnestly urge other county highway organizations to consider the use of two-way radio communication. We are sure that they will come to the same conclusion we have formed—that you can't afford to be without it."

With the availability of additional frequencies it is expected that many additional radio communication systems in highway departments will be installed and that those highway departments using this method of communication will expand their facilities.

Equipment and Installation

In setting up a radio communication system in a highway department the proper selection of equipment is most important and

FIGURE 5. Showing interior installation in automobile

should not be undertaken without adequate planning and technical advice. There are several manufacturers of reliable equipment suitable for use in connection with highway activities.

This equipment must be highly engineered and built to withstand the elements, extensive temperature changes and shock when mounted in trucks and similar equipment.

Now that the permissible use of radio has been expanded and a reasonably adequate number of frequencies made available, the manufacturers of radio equipment have started producing new units. These units are more serviceable, more compact and provide greater voice fidelity than those previously available.

Radio equipment should be installed so that units can be readily taken from one truck and placed in another, if necessary. This requires standard battery cable connections, antennae connections and suitable space for mounting on each piece of motorized equipment on which radio may be used.

Types of Radio Service Available

At present, three types of radio service are available:

1. Commercial service furnished by communication companies. Several of the large communication companies will furnish radio services on a rental basis. The company furnishes, installs and maintains the equipment. The communication system is completely under the control of the Highway Department and provides a private communication system. Such a system consists of a land station and mobile units. The rental charges for locally controlled land stations are from $40 to $60 per month. The rental on remotely controlled land stations runs from $60 to $120 per month. The rental charge for mobile units mounted in equipment is approximately $20 per month. In some instances installation charges are made.

2. The major communication companies will also furnish a type of service known as suburban radio-phone service. This equipment, when installed, in automobiles or trucks, permits the operator to communicate with a telephone central office by radio. From there the communication is over wired facilities to any point. The cost of this service is approximately $25 per month with a charge of fifteen cents for local calls. Long distance calls take the local charge plus the long distance telephone charges. This type of service is useful in areas within range of radio telephone central offices.

3. Privately owned radio systems: Highway departments may purchase outright all radio equipment required for their use. They may either set up an

organization for the maintenance of this equipment or may obtain maintenance agreements with companies providing this service. By this method, the entire radio communications system is under the jurisdiction of the owning municipality and is operated as a private communication system. Installations for locally controlled land stations cost from $500 to $1,000. Remotely controlled land stations cost from $1,000 to $2,500. The above costs are dependent on the power of the station and the antenna required. Mobile units cost from $450 to $550. The monthly maintenance varies from $5 to $20 per unit, depending on the age and type of equipment, servicing personnel, etc.

From every standpoint, radio-telephone has already well-justified itself. In the day to day routine operations of a highway department, it has proved its worth time and again. Obviously a dollar-and-cents accounting is impractical, but all of the highway departments that have used this medium of communication are satisfied that a large and important link in the communication chain has been forged by the radio telephone.

Any imaginative probing into the future must reveal added advantages. As other Public Safety services adopt this method of communication, added benefits will accrue. The expanded use of radio by commercial truckers, school busses, doctors, fire companies, disaster and emergency agencies will soon produce a series of communication channels that could be merged into one great national defense network if necessary.

With the added flexibility in operating a highway system made possible by the use of radio, another chapter is written in the manual for providing safer and more convenient transportation facilities for the 150 million residents of the United States who are the only people in the world that have the opportunity to appreciate and enjoy the advantages of automobile transportation.

Rules governing Public Safety Radio Services published by the F.C.C. are available for distribution.

Some of the Economic Aspects of Highway Planning

THOMAS J. FRATAR

Mr. Fratar is engineer-economist with the Knappen Tippets Abbett Engineering Company. He has supervised numerous economic studies for transportation facilities both in this country and abroad. During World War II, he served as Valuation Engineer in the operation of the Iranian State Railroad. Previously he had been associated with the Bureau of Highway Traffic at Yale University on research studies dealing with the economics of automotive transportation. Much of the data on estimated unit costs in this article were developed in his work at Yale.

IT IS fundamental that funds for any purpose should be invested in a manner that will obtain the greatest return on the investment. Nowhere is this axiom more applicable than in the planning and designing of traffic facilities. Indirect benefits to the public at large, and direct benefits to highway users, are both valid returns that must be summarized and compared with the costs of the facilities in order to determine the economic soundness of the investment.

Judgment and experience of the engineer are exceedingly important in anticipating a proposed project's various influences on costs and benefits, and in arriving at sound conclusions. The engineer must have factual data regarding existing highway uses and economic, industrial and social conditions. In some cases, the histories of the changes that followed the construction of existing comparable facilities are important guides. At other times, the engineer is faced with problems that have little precedent.

Each proposed facility must be investigated and evaluated in the light of conditions peculiar to it, particularly with reference to effects the facility will have on industry, commerce, real estate values and established utilities. Many benefits are not easily reduced to monetary terms. However, some of the direct costs to highway users can be expressed in more or less average values that can be

applied generally within reasonable limits of accuracy. Quite often the cumulative effect of these costs is great. The determination of totals for a given traffic stream is exceedingly important in demonstrating the economic justification for improvements. This article suggests unit-values for some of the direct costs and, in a general way, the means by which these values may be applied in economic analyses.

Fuel Costs of Stop and Go Driving

In areas of traffic congestion, the fuel consumed per vehicle mile is significantly greater than in areas of unimpeded traffic movement at ordinary and generally acceptable speeds. It is well known that for constant speed operation, the fuel consumption is greater at high speeds than at low speeds. Charts showing average mileage at various speeds are familiar to all traffic engineers. However, average values for the fuel waste inherent in the low average speed of stop and go driving are more difficult to determine and are not commonly available.

At the request of the Yale Bureau of Highway Traffic, a series of tests were conducted by an automobile manufacturer in 1940 to investigate the effects of stop-cycles and slow-down cycles on the fuel consumption of passenger cars. The cruising speeds selected were 20, 30, 40 and 50 miles per hour and an investigation was made of both "easy" stop-cycles and "hard" stop-cycles. Each stop-cycle consisted of stopping from the cruising speed, idling for approximately ten seconds and accelerating to the initial speed. For example: Run at twenty miles an hour; stop; idle for ten seconds; and accelerate to twenty miles an hour. Presumably, *easy* stop-cycles were comparable in deceleration and acceleration values to the usual corresponding movements of a vehicle operated by a good driver while *hard* stop-cycles corresponded to emergency stops and rapid acceleration.

The vehicles used in the tests covered a wide range in age and weight. They were representative samples of the passenger cars in use in 1940. They probably differ only slightly in characteristics from the average passenger car in use today. A summary of the results of the stop-cycle tests is given in the following table.

TYPICAL VALUES OF INCREASED FUEL CONSUMPTION OF PASSENGER CARS FOR VARIOUS STOP-CYCLES

Cycles (Speed Range in M.P.H.)	*Fuel Used Increased by Cycle*	*Cost of Increased Fuel (at 25¢ Per Gallon)*
	Gallons	*Cents*
20–0–20 Easy	0.0035	0.087
20–0–20 Hard	0.0045	0.112
30–0–30 Easy	0.0050	0.125
30–0–30 Hard	0.0069	0.172
40–0–40 Easy	0.0066	0.165
50–0–50 Easy	0.0090	0.225
50–0–50 Hard	0.0109	0.273

NOTE: Idling consumption averaged 0.0069 gallons per minute, which represents a cost of 0.173 cents per minute if gasoline costs 25 cents per gallon.

A comparison of the stop-cycle consumption with records of the mileage obtainable at constant speed operation shows that at a cruising speed of thirty miles an hour with three easy stops per mile, the average passenger car consumes the same amount of fuel per mile as it does at a constant speed of about fifty-five miles an hour. A hard stop-cycle from twenty miles an hour increases the fuel consumption rate by more than 300 per cent over that required to traverse the same distance at a constant speed of twenty miles an hour. With an increase in cruising speed the percentage increase diminishes but even at 50 miles per hour it amounts to more than 100 per cent.

In conjunction with those stop-cycle studies, slow-down cycles were investigated in which the speed was reduced from fifty to thirty miles an hour and accelerated again to fifty miles an hour, in both easy and hard cycles. Although the hard cycles showed over fifty per cent increase in the rate of fuel consumption, there was no significant change in the rate for the easy cycle. These results might be expected since there was no shifting of gears and the cycle carried the vehicle through more favorable economy ranges.

The magnitude of the fuel losses arising from congestion in a large city can best be shown by example. In an area of about 2.4 sq.

miles in one large city it was found that during several hours of the day the average vehicle was required to stop about one and one-quarter times a minute, the average speed was about 9 miles per hour, and approximately 50 per cent of the total traffic time was consumed while motionless. The average weekday traffic represented about 90,000 vehicle hours of which 45,000 vehicle hours were consumed while idling. This represented a fuel wastage of about 18,000 gallons a day. The wastage due to stops, exclusive of idling time at the rate of about 0.0024 gallon per stop totaled about 16,000 gallons a day. The total weekday wastage of 34,000 gallons represented a direct cost of about $8,500 to the motorists. This corresponded to approximately double the normal fuel consumption for constant speed operation at twenty m.p.h.

It is not suggested that in any instance the *total* losses can be avoided. Yet any traffic improvement that will relieve conditions of fuel wastage should properly be credited with the amount of the savings that such improvement will effect. In the example given, if one-half of the loss could be eliminated by a particular project, annual savings in the order of one and one-quarter million dollars would be effected. These savings should properly be credited to the project.

The Value of Vehicle Time

The value of time to vehicle operators is indicated by their willingness to pay to avoid time losses, but there is little agreement on *how much* the average operator will pay. Furthermore, that amount may be quite different from the actual benefit to operator, and, in a general sense, to society as a whole. How much each driver will pay in a particular instance probably varies considerably, depending on the time saved, his ability to pay, the general conditions of traffic, the urgency of his trip and other factors. In many instances, the time savings do not return benefits in money earned but at other times the savings can be profitably used and can thereby result in an income.

It is probably true that few drivers know how much time they save by using a given facility as against another facility it took the place of, or even a parallel existing facility. Probably only a small

percentage of drivers have any idea how much their driving time is worth. Nevertheless, the savings are of benefit and should be included in the economic analysis of a proposed free facility, even though many drivers would not be able or willing to pay for the time saved.

This, of course, is a much broader viewpoint than could be applied in the analysis of a proposed toll structure that would have to produce actual earnings to meet expenses and to amortize the investment.

Estimates of the unit value of passenger car-time range from one cent a minute to about two cents a minute. Some indication of unit-time values is given by the use and charges of toll structures where alternate free facilities are available and also by public opinion polls. In both cases the results are probably influenced by other factors, as well as by time savings, such as distance, traffic irritations and highway markings. Under current conditions, two cents a minute is believed to be a conservative value of passenger car-time. During conditions of restricted automobile use and high car occupancy as in the recent war period, a higher unit value should be used.

Estimates of the unit time value of a commercial vehicle have sometimes been made by dividing the total fixed cost of owning the vehicle by the total time the vehicle is in service, but that quotient may be far removed from the actual or potential value of the time saved. The fixed costs cannot necessarily be diminished by a reduction in delays and they are relatively small compared to the driver's wages. Additional expenses due to delays may involve perishable goods, loss of business, overtime pay or other items peculiar to different types of business.

Again, as in case of the passenger car, the unit-time value of a commercial vehicle cannot be exactly established. Undoubtedly a value somewhat higher than the average rate of pay of the driver of a typical truck should be used. A value of three cents a minute is suggested as reasonable for the purposes of estimating over-all benefits.

In the example given previously, for the specified area, 90,000 vehicle hours were consumed per day and the average speed was nine miles an hour. If improvements were to increase the average speed to

20 miles per hour, approximately 57,000 vehicle hours per day would be saved. Assuming that the weighted average value of passenger car and truck time is 2.2 cents a minute for this case, the total savings in time values each weekday would be approximately $66,000 and the annual savings would be in the order of $20,000,000. An improvement that would raise the speed of all traffic in this area to that level is manifestly not practicable, but the illustration serves emphatically to show the economic value of this item.

Vehicle Unit Operating Costs

The cost of owning and operating a vehicle includes many items; some are independent of the extent to which the vehicle is operated and others are directly related to the mileage traveled. In determining the unit operating costs a distinction must be made between mileage costs and nonmileage costs. Each of the items entering into operating costs, except depreciation, can be wholly assigned without question to one or the other of the two classifications. Depreciation, however, is fundamentally controlled by two factors—mileage and age.

Under normal conditions, the depreciation of most passenger cars would be governed more by age than by mileage since the rate of use would not bring about obsolescence as rapidly as changes in models. In the case of trucks, however, it is frequently difficult to distinguish depreciation from deferred maintenance. For these reasons, depreciation should be included as a non-mileage cost for passenger cars and as a mileage cost for trucks. On that basis the mileage element cost for passenger cars would include the cost of fuel, lubricants, tires and tubes, general repairs and miscellaneous expenses. For trucks, the mileage element cost would include all of these items plus depreciation.

Studies made in 1940 for the Yale Bureau of Highway Traffic showed that such costs for an average passenger car were in the order of 1.5 cents a mile if the economies of fleet operation were proportionately represented. For light, medium and heavy trucks average costs per mile were found to be approximately 3.3, 5.1 and 9.8 cents respectively. It is believed that the increases in costs of operation

since that time call for increasing these unit costs by about 33% to about 2.0 cents per mile for passenger cars and 4.4, 6.8 and 13.1 cents per mile, respectively, for light, medium and heavy trucks.

In a recent study for a proposed bridge it was estimated that during the life of the bridge an average of 7,000,000 trips a year would be made over the bridge, with a resultant savings of at least 20,000,000 vehicle miles a year. Assuming, for illustration, a weighted unit vehicle operating cost of 2.2 cents a vehicle mile, the annual benefits resulting from distance saved would be about $440,000 a year.

Losses Due to Accidents

Traffic accidents each year cause appalling losses in lives, injuries and property damage. Design features cannot eliminate accidents, but judicious designing can make it difficult for accidents to occur. An analysis of the types and causes of accidents provides reasonably accurate estimates of the benefits of various highway features. Many case histories available cover accident records before and after improvements were made. These records serve as useful guides for estimating the effect of a proposed improvement on the accident frequency of a given highway facility.

Losses in lives and in personal injuries are certainly understated when they are reduced to dollars and cents. Yet monetary values must be used in order that comparisons may be made of various projects and in order that, to a reasonable extent at least, the accident prevention measures of a proposed highway facility receive credit for definite savings. For estimating purposes, average values for the losses can be found from analyses of the settlement of claims for loss of life, personal injuries and property damage accidents. These values may vary somewhat for different areas of the country.

An excellent example of accident losses and subsequent prevention of much of the losses is found in the accident records of a section of a highway converted, a few years ago, from an undivided highway to a divided highway at a cost of about $500,000. Using values found to be average at that time, of $11,500 for each death, $425 for each personal injury, and $125 for each property damage accident, the yearly savings totalled almost $190,000 a year.

Summary

Highway funds are notoriously insufficient to meet even the constantly increasing demands for urgently needed physical improvements. Consequently it is frequently impossible to undertake the essential comprehensive studies that would show current economic losses from inadequate facilities and the over-all effects that proposed facilities would have on the costs and benefits to the highway users and to the public at large. There is little doubt that there would be a tremendous movement for highway improvements if all losses from inadequate and insufficient highway facilities could be evaluated, compared with estimates of the costs of improvements, and demonstrated to highway users, taxpayers and legislative bodies.

There are indications of an increasing awareness of the need for comprehensive economic surveys preparatory to proceeding with plans for highway improvements and preparatory to demonstrating the need for improvements to the public and to legislative bodies. Excellent studies may be found in state-wide planning surveys and in the work of civic planning-groups.

Much of the work is aided by extensive origin and destination surveys sponsored or assisted by the Public Roads Administration. These studies point the way for many more major comprehensive studies, and for construction programs that should be undertaken in order to recover from our present highway troubles, and in order that we, too, do not pass on greater problems to succeeding generations.

Trucks, Traffic and Terminals

WILLIAM R. MCCONOCHIE

Mr. McConochie is Chief of the Traffic and Transportation Section of De Leuw, Cather and Company, consulting engineers. He has planned reports for comprehensive systems of expressways, for the coordination of express bus service on expressways, for the modernization of local transit lines, and for parking facilities and truck terminal studies. Previously he was Project Manager for the same engineering firm. Mr. McConochie has also served as a lecturer at the Northwestern University Traffic Institute, as a traffic engineer for the Chicago Surface Lines, and as Superintendent and Junior Engineer (1928–30) on Mississippi River improvement work for the Corps of Engineers, U. S. Army. He is a member of the American Society of Civil Engineers and of the Institute of Traffic Engineers.

AN INTERESTING plan for new cities of 50-to-100 thousand population was presented by Professor Alexander Klein of the Technion at Haifa in the July 1949 issue of TRAFFIC QUARTERLY. One of the principal features of this plan was to locate truck and other transportation terminals on the periphery of new cities rather than in or adjacent to a central business district.

No doubt there will be opportunities for newly created cities in Israel, where Professor Klein is teaching, as well as in other war-torn countries yet to be rebuilt. The problem in this country, however, is chiefly to rebuild existing cities "under traffic." In fact, our cities are rebuilding themselves at an astonishing rate, and many of Professor Klein's proposals are being used of free choice without the benefit of overall planning.

One example is in the location of truck terminals. Truck terminals in the past have been predominantly in or near central business districts. Site location has been based in part on availability of rail or water transportation and also on the proximity to light manufacturing establishments, the chief customers of trucking companies. Now the light manufacturers are moving outward, truck-to-rail movements are declining in relative importance, and central

business districts are so badly congested that the cost of doing business in a centrally located terminal is prohibitive.

Experience in Milwaukee and Louisville

Recent studies in Milwaukee show that 17.7 per cent of all vehicles entering the downtown area are trucks. Other studies on the adequacy of streets serving that area indicate that by 1960 the combined capacity of all streets to the west side will be only 89 per cent of the anticipated rush-hour traffic. The four bridges serving the south side will have excess capacity to the extent of about 9 per cent of anticipated traffic, which is less than the normal seasonal fluctuations. In this particular city the construction of proposed expressways will offset these deficiencies in capacity, but rate of movement on surface streets is likely to remain far too slow for efficient truck operation.

A similar situation has been found in Louisville in that the combined capacity of all streets serving the downtown area will be insufficient for rush hour traffic within the next few years, if traffic continues to increase at the predicted rate.

In both Louisville and Milwaukee recent strikes of bus and street car operators have conclusively proved those conclusions. During these strikes the volume of traffic in each city was less than 25 per cent over that prevailing normally, and yet traffic in both cities was paralyzed and truck deliveries became completely disorganized. It is estimated for both cities that before 1960 increases in traffic will produce volumes exceeding those which were recorded during the transit strikes.

Truck traffic has received surprisingly little attention in many urban highway planning reports. We have been misled, perhaps, by the relatively small proportion of total registered vehicles that are trucks. In Milwaukee, for example, only 11 per cent of the registrations represent commercial vehicles. This small group, however, accounts for 24 per cent of all trips made in the metropolitan area during a normal weekday. Since the effect of a truck on the traffic stream is equivalent to two private passenger vehicles, and further, since many of the passenger vehicles use parkways and boulevards provided exclusively for their use, the average city street is already

carrying 35 to 45 per cent commercial traffic. Considering the relative operating costs of the two types of vehicles, truck traffic now predominates in many cases in the economics of urban traffic problems.

Significant Increase in Truck Traffic

Truck traffic has been increasing more rapidly than many people realize. Just before the war there were 1200 Class I interstate truckers in this country doing an annual gross business of approximately $700,000,000. In 1948 there were 2500 interstate truckers with a gross business of $1,667,000,000. Even accounting for increases in freight rates, this type of business has increased by two-thirds in less than ten years.

There seem to be no limitations on the type of freight now accepted by trucking companies, or on the distance freight can be hauled. Stockyards, originally designed to be served exclusively by rail, report as many as 90 per cent of their animals being received by truck. Steel is being hauled from Pittsburgh to Detroit in large tonnages by truck, at 10 per cent below the prevailing railroad rate. Refrigerated loads of fish can be hauled from the State of Washington to New York City more cheaply on the highway than on the railroad. Motorcycles are shipped uncrated, cloth goes from mill to factory without passing through a warehouse, and other economies in freight transportation are being developed daily by the trucking industry.

How great the volume of truck traffic will become is anybody's guess. Projection of past trends does not take into account the possible future effect of new and better highways, particularly urban expressways; relaxation of existing size and weight limitations; the ability of the railroads to meet competition with new techniques; future tax policies in regard to trucking; increase in wage rates more nearly in line with those of the railroads; or the dampening effect of increased traffic congestion in our urban areas.

We know that railroads still handle ten times as many ton-miles of freight as the trucks. It seems probable that truck business will double or triple within the next few years, largely at the expense of the railroads. This prediction is made without prejudice in favor of the trucking industry. A major portion of the work of the author's

firm is for or in connection with railroads. It seems reasonably certain, even on a much more conservative basis, that future growth will make most existing truck terminals outmoded in size, location and freight-handling methods. This will present an opportunity to relocate them to serve shippers and consignees better than at present, and at the same time to relieve some of our pressing traffic problems.

Wisconsin Studies Show Truck-freighting Increase

A large proportion of truck movements represent door-to-door delivery and no truck terminal is involved. The use of large highway trucks for general freight traffic is increasing rapidly, however. Studies in Wisconsin at twelve loadometer stations show that general freight traffic in 1936 represented 10.1 per cent of the total material hauled by trucks. By 1944 this classification had increased to 19.7 per cent, and in 1948 reached 21.1 per cent. The number of trucks engaged in hauling general freight, of those stopped at the loadometer stations, increased from 6.0 per cent in 1936 to 12.5 per cent in 1944, and 14.0 per cent in 1948.

General freight is usually consolidated from a number of shippers and then distributed at the other end of the trip to various consignees. Larger companies have route trucks operating from terminals for delivery to ultimate recipients, but the smaller companies operating only one or two trucks sometimes use tractor-trailer combinations to furnish door-to-door pickup and delivery of less-than-truckload freight.

A related problem concerns general freight arriving by rail which must be transferred to trucks for delivery to ultimate destinations. Most of the terminals for this purpose are located in or near the central business district, although only a limited portion of the total freight is destined to this area.

Truck Terminals Recommended

Large truck terminals at the outer limits of the Milwaukee metropolitan area have recently been recommended in connection with a highway planning report. Such terminals would intercept over-

the-road trucks as they approach the city and permit their freight to be transferred to route trucks for delivery to consignees with a minimum of back-tracking and duplication of truck mileage. These terminals would tend to draw truck traffic outward along streets having capacity to serve it, relieving the central core of the city.

Sites were selected which would provide access to one or more railroads so that less-than-carload freight could be transferred to route trucks at points most favorable for city-wide distribution.

Another worthwhile advantage of the outlying terminals is that the large acreage necessary for proper operations and truck maintenance facilities could be acquired at a nominal price compared to the cost of a new terminal site in the older built-up sections of the city. The terminals, being adjacent to railroads, would not have any serious effect on future suburban growth for residential purposes.

Selecting Sites for Truck Terminals

Two of the most important considerations in selecting the sites for outlying truck terminals in Milwaukee were that they be adjacent to existing principally-traveled highways, and also that they be close to routes of the recommended expressways. Thus much of the future truck traffic from these terminals into the city can be on facilities properly designed from the standpoint of lane widths, capacity of structures, and segregation from pedestrians. Truck operations on the surface streets will be reduced to the smallest practicable amount. If site selection were left to chance or to the whims of private operators, it is likely that spurs from the expressway system would be required in the future or that truck traffic would have to continue to use the surface arteries.

This, it would seem, is one application of the principles advanced by Professor Klein. Perhaps many of the advantages he sees in the centrifugal city can be realized by guiding the rebuilding of some of our older American cities.

Effect of Accident and Cost Trends On Automobile Insurance Premiums

RICHARD O. BENNETT

Mr. Bennett is traffic safety consultant, Accident and Fire Prevention Division, National Association of Automotive Mutual Insurance Companies at Chicago. He was formerly senior traffic safety consultant for the National Safety Council. Mr. Bennett first became interested in traffic safety during ten years of editorial work on the Lincoln, Nebraska, State Journal. He left the newspaper field to join the Lincoln police department. Later, as a lieutenant, he commanded the police traffic division. He won a Kemper Fellowship in 1936 and was graduated from Northwestern University's Traffic Institute. Later he was managing director of the Lansing, Mich., safety council, and director of safety and personnel for Great Lakes Greyhound Lines, Inc., at Detroit. He is a member of the International Association of Chiefs of Police and an affiliate of the Institute of Traffic Engineers.

FIVE years after the Duryea brothers built the first American gasoline automobile—in 1898 to be specific—the owner of "a self-propelled vehicle" (the record doesn't show whether it was steam or gasoline driven) appealed to his insurance company for a policy to protect him from loss if his vehicle inflicted damage on the person or property of another. The company was not found wanting and a new industry was born in America—automobile liability insurance.

In the strictest sense of the word this was not an automobile liability policy. It was an endorsement on a *teams' liability policy*—teams' policies being those affording insurance protection for owners of *animal-drawn* vehicles. The first separate automobile liability policy was not issued until 1901.

The modern automobile liability insurance policy is no more like that first policy than is the modern automobile, with its hydramatic shift, synchromesh gears, futuramic lines and dynaflow transmission, like the chain-driven foul-smelling horseless carriages that made industrial history early in this century. The policy issued in 1901, and those that followed for nearly a quarter of a century, were

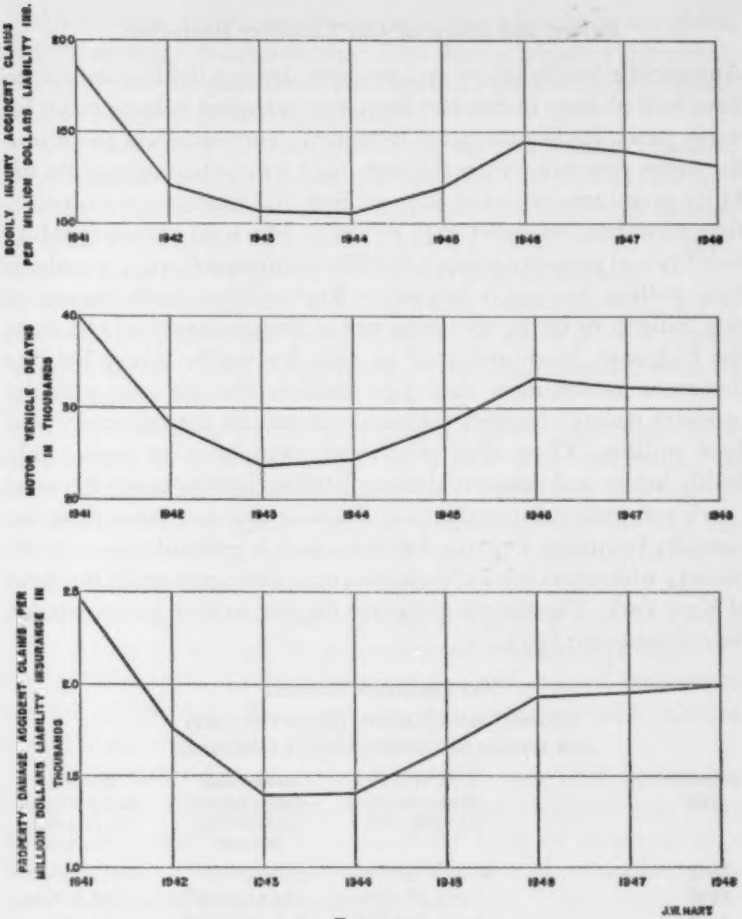


FIGURE 1

written for one vehicle and one driver. The modern automobile liability insurance policy offers complete coverage and protects the owner against personal loss regardless of who is at the wheel. The automotive insurance industry has kept pace with the rapid and revolutionary changes in American travel patterns, practices and habits and is offering the motoring public liability protection in every conceivable situation.

Extent and Scope of Car Liability Insurance

Automobile bodily injury and property damage liability combined have bulked large in casualty insurance premium volume totals for many years, having exceeded workmen's compensation premiums for every year from 1927 through 1947 when the automobile liability premiums exceeded $677 million and workmen's compensation premiums exceeded $641 millions. The total of bodily injury liability and property damage liability premiums in 1941 was about $460 million. In 1944 it dropped to $448 million chiefly because of rate reductions in the war years and to disappearance of cars from the highways. Premiums paid in 1947 for bodily injury liability insurance totaled more than $471 million. For the same year the property damage liability insurance premiums totaled more than $206 million. These data on written premiums for automobile bodily injury and property damage liability insurance are the most nearly comprehensive available at this time and were taken from the Casualty Insurance Expense Exhibit which is a consolidation of the country-wide experience of insurance companies entered in the State of New York. The figures given are the net written premiums for the calendar year 1947.

NET PREMIUMS WRITTEN
AUTOMOBILE LIABILITY (BODILY INJURY)
AND WORKMENS' COMPENSATION COMPARED.

Calendar Year	*Total Written Premium—All Casualty Lines*	*Automobile Bodily Injury Net Premiums Written*	*Workmens' Compensation Net Premiums Written*
1945	$1,579,652,000	$338,541,000*	$477,230,000
1946	1,935,381,000	474,515,000*	497,078,000
1947	2,501,727,000	615,960,000*	641,085,000

* The Automobile liability figures in the above tabulation are only bodily injury net premiums, and do not include automobile property damage net premiums or premiums covering automobile physical damage, such as fire, theft and collision.

NOTE—The source of the above information is THE SPECTATOR, Insurance Year Book. The number of companies included for each of the three years are: 1945, 290; 1946, 293; 1947, 306.

Automobile insurance in this country, while not the oldest casualty coverage, is considerably older than workmen's compensation insurance. Its growth has paralleled the growth in the production and registration of automobiles.

The automobile insurance coverage may be broadly classified in two groups—liability and physical damage. The primary liability coverage is bodily injury liability insurance that covers the insured for sums he becomes obligated to pay by reason of the liability imposed upon him by law for damages, including damages for care and loss of services, because of bodily injury, including death at any time resulting therefrom, sustained by any person or persons, caused by accident and arising out of the ownership, maintenance or use of the insured automobile.

The property damage liability coverage provides such insurance with respect to damages because of injury to or destruction of property, including the loss of use thereof. A relatively new form of casualty coverage is medical payments insurance under which the company agrees to pay to or for each person who sustains bodily injury caused by accident and arising out of the use of the insured automobile while in, or upon entering or alighting from it, while it is being used by or with the permission of the named insured, the reasonable expense of various necessary hospital and medical services and funeral expenses. Payment under this coverage is made without regard to fault or liability of the insured.

The physical damage coverages include insurance against loss by fire, theft, transportation, water damage, collision and other hazards. In addition there is a popular form of comprehensive insurance which covers substantially all losses to the described automobile except those due to collision.

The average American motorist takes his automobile liability insurance for granted. He rarely reads provisions that set forth the protection he is buying and properly trusting. Only on two occasions does he show interest in his liability insurance—after an accident and when he pays his insurance premium. When he pays the premium, he may ask: "What determines the public liability and property damage insurance *rate*?"

Factors in Rate Determination

Some think the rate is "picked out of the blue" and that reasonably prudent drivers are asked to pay more than they should. Yet drivers help fix the rate. Insurance rate determination is a highly developed science. Many factors are involved. The expensive and extensive chrome grill on the front of one's new automobile, for instance, makes the insurance rate a mite higher, at least indirectly.

Rate experts watch two "barometers" closely. These indicate automobile bodily injury and property damage claim frequency and average claim cost. As these go up or down, so does the rate the average motorist must pay for liability insurance.

Factors affecting claim frequency and claim cost are so numerous no attempt will be made herein to list them all. A few of the major factors affecting claim frequencies are legislation, number of insured vehicles, economic conditions, car use, car-use restrictions and national and local accident trends. Claim-costs are affected by such factors as automotive engineering and styling, cost of replacement parts, wage scales, cost of medical attention and hospitalization and size of court judgments.

The first factor affecting claim frequency is the matter of legislation which is tied in with number of vehicles insured. As more and more state legislatures pass safety responsibility and compulsory insurance laws, more and more automobiles are being insured. These include many which otherwise would not be insured and many which are not considered good "insurance risks" by the underwriters. Of course, an insurance company has the privilege of refusing to insure a "poor risk," but, if the car owner *must* have insurance, the "assigned risk" procedure is used under which all carriers share undesirable risks.

Responsibility Laws in all but Four States

Safety (or financial) responsibility laws have literally "swept the nation." The first law of its kind, a relatively simple statute, was adopted by Connecticut in 1925 and became effective in 1926. The 1949 report of the President's Highway Safety Conference Commit-

tee on Laws and Ordinances classes all but four states as having some form of safety responsibility laws. Legislatures of some of the remaining four states considered safety responsibility legislation at 1949 sessions, while others revised existing statutes.

There is a wide variation in existing laws, however. For the most part they provide a method intended to approximate the beneficial results seemingly guaranteed by comprehensive compulsory insurance, by requiring proof of ability to respond in damages. This does not necessarily apply to all motor vehicle operators, but only to those who may be likely to cause harm, having demonstrated through certain dangerous acts a possible tendency to be negligent. That certain drivers, a small group to be sure, are more prone than others to be involved in accidents has found support in studies made under the auspices of the National Research Council.

It should be obvious that, as the number of insured motor vehicles increases, so do the number of claims. As recently as 1940 it was reported reliably that less than one automobile out of five was insured for liability. Today this same source says that approximately three out of every five automobiles are insured for liability.

More vehicles are covered by public liability and property damage insurance during boom times than during periods of depression. National economic conditions, therefore, affect the number of vehicles covered. This may be reflected in the bodily injury and property damage claim frequency. The influence on claim frequency is not as great in this instance, since frequency rates are based on premium volume.

Restrictions imposed during World War II on the use of motor vehicles—gasoline rationing, curtailment of speed and the unavailability of automobiles, parts and tires—affected materially the claim frequency because fewer automobiles were used, and those on the road were travelling fewer miles at lower speeds.

The frequency of bodily injury and property damage claims rises and falls with the national motor vehicle traffic death rate, despite the fact that non-fatal injury and property damage accidents are not considered when these national rates are computed. The number of persons killed annually in motor vehicle traffic accidents rose steadily from 1918, when they numbered 10,700, to 1941 when

the all-time high of 39,969 was reached. The low figure during the war was 23,823 in 1943. After wartime restrictions were lifted the number of traffic fatalities went up sharply until 1946 when they numbered 33,411. A drop of more than 1000 followed in 1947, to 32,300 and another slight decline in 1948 brought the national total to 32,000.

Injury Claims Fluctuate with Fatalities

The number of bodily injury accident claims per $1,000,000 insurance in force (see accompanying table) parallels the fluctuations of traffic fatalities. A high of 185 bodily injury claims reached in 1941 was followed by a low of 106 in 1944. A postwar high of 145 was recorded for 1946. In 1948 they numbered 133. The number of property damage claims per $1,000,000 insurance in force likewise reached a high in 1941 when there were 2,456 such claims. A low of 1,393 was recorded in 1943. The postwar high was marked up in 1948 when there were 1,987 such claims per $1,000,000 insurance in force.

AUTOMOBILE PROPERTY DAMAGE CLAIM
FREQUENCIES AND AVERAGE CLAIM COSTS

COUNTRYWIDE
(Stock and Mutual Companies Combined)

	Number of Accident Reports (Claims) Per $1,000,000 Liability Insurance in Force	*Countrywide Average Claim Costs*
1941	2,456	30.84
1942	1,756	34.54
1943	1,393	40.81
1944	1,404	48.36
1945	1,658	51.38
1946	1,934	55.11
1947	1,952	60.33
1948	1,987	65.05

NOTE—The above Automobile bodily injury and property damage claim frequencies and average claim cost figures are based on the combined experience of most of the casualty insurance companies in the United States.

There are still other factors, including increased power and speed of automobiles, increased congestion, increased winter and family use, and the general increase in miles of travel by individual vehicles. Because of the inability to measure the results, no attempt was made here to show the effect on accident and claim frequencies resulting from organized efforts to minimize accidents; from increased enforcement attention; from more strict driver license requirements; from motor vehicle inspection; from driver education and training; from pedestrian regulation and the like. These, for the most part, are localized but nonetheless are highly effective.

Factors Affecting Claim Costs

Examining the factors affecting average claim costs, we are first confronted with automotive engineering and styling, which works both ways—to increase costs and to reduce costs. On the favorable side of the ledger we find such engineering improvements as all steel bodies, safety glass, more efficient braking systems, blow-out proof inner tubes, and improved headlights which, there is no doubt, have reduced the frequency and severity of injuries resulting from motor vehicle accidents and probably have tended to cut accident frequency.

On the other side of the ledger, we find automobiles so constructed that a smashed fender means rebuilding a large part of the body, whereas with earlier models it simply meant replacing a comparatively inexpensive fender. More and more expensive chrome is being used and the grill work on late model cars is such that replacements rather than repairs are made necessary by even the most minor accident. Late model cars are capable of higher speeds. More high-speed highways are being constructed. This combination means more damage and more severe injuries if an accident does occur.

Dr. Fletcher D. Woodward, M.D., Charlottesville, Virginia, in an address printed in the October 30, 1948 issue of *The Journal of The American Medical Association,* reported on a study he made to prove that many motor vehicle deaths and injuries could be prevented by modifications in automotive designs. Dr. Woodward stated, ". . . in studying the types of accidents as seen in the Univer-

sity Hospital of Virginia, certain injuries were observed to predominate. These are injuries to the face and head, usually caused by impact of the head against the dashboard, the windshield or the rear of the front seat. Crushing injuries to the chest of the driver occur when he is driven against the steering wheel. Injuries to the head, pelvis, patella and femur are caused by the protective rotation of the body when propelled forward on impact. Injuries to the elbow are usually caused by a blow to the elbow when projecting from the window and usually affect the driver.

"Of course, many other types of injuries occur, of greater or lesser degree, but these comprise the most serious and the most frequent in our experience. Associated with many of these are internal injuries to the abdominal viscera, lungs and brain. Studying the reasons for and the mechanics of these accidents makes obvious that redesign of the automobile can prevent many."

Dr. Woodward declared there is evidence that the adoption of construction methods and safety features, now employed by the aviation industry, would render it at present possible to build motor cars capable of withstanding collision, leaving the road at high speed and overturning, with greatly reduced likelihood of injury to the occupants, as well as reducing the likelihood of such accidents.

"Automobiles should be redesigned," Dr. Woodward asserted, "to stress safety rather than speed and appearance."

Marked Increase in Cost of Parts and Repairs

The cost of automotive replacement parts has increased sharply since the lifting of OPA ceilings. This condition, coupled with higher wages now being paid automobile mechanics, body men and painters, has caused the cost of repairing motor vehicles involved in accidents to skyrocket, affecting materially the average claim cost.

The increased cost of automobile repairs since the war has been of concern to all automobile insurance claims personnel. One of the methods devised for meeting the problem has been a plan, with variations, for using the services of an independent expert auto-

mobile appraiser to estimate and verify the costs of repairing a damaged automobile. This independent appraisal plan has been adopted by members of several Casualty Insurance Claim Managers' Councils with excellent results. These Claim Managers' Councils are made up of member companies of the National Association of Mutual Casualty Companies and the Association of Casualty & Surety Companies. Such councils exist in forty-two cities.

Many Other Costs Higher, Too

Hospitalization and medical attention cost more today than during war and in prewar years. As the result of hospitalization insurance, many persons avail themselves of hospital care who otherwise would have stayed away.

In keeping with the inflationary trend, juries in some jurisdictions have been more liberal in awarding damages in contested accident cases. Court costs and attorney fees likewise are more than they were.

The tendency toward inflation has not bypassed the insurance industry. Salaries, printing, advertising and general operating expenses have climbed. Insurance companies are expanding to meet the increased demand for broader insurance coverage. As the frequency of claims increases, so must the size of the staff needed to properly service the insured. More and more money is being expended annually by insurance companies and their respective associations for safety engineering and for accident prevention activities, much of which is in support of programs of other organizations concerned with preventing traffic accidents. These affect cost of doing business for an insurance company, but do not directly affect premiums. These costs are included in the expense provision in insurance rates, that provision having been an established percentage of the premium for many years.

The countrywide average automobile bodily injury claim cost (see accompanying table) was 41 per cent higher in 1948 than in 1941. During the last prewar year, the average claim paid for bodily injuries was $298.76 as compared with $421.24 in 1948. The increase

in property damage claims paid was even more pronounced, jumping from $30.84 in 1941 to $65.05 in 1948, an increase of 111 per cent.

AUTOMOBILE BODILY INJURY CLAIM FREQUENCIES AND AVERAGE CLAIM COSTS

COUNTRYWIDE

(Stock and Mutual Companies Combined)

	Number of Accident Reports (Claims) Per $1,000,000 Liability Insurance in Force	*Countrywide Average Claim Costs*
1941	185	$298.76
1942	122	358.82
1943	107	382.19
1944	106	380.66
1945	120	350.17
1946	145	357.88
1947	140	381.82
1948	133	421.24

Four Risk Classifications

Another factor affecting the rate the average motorist must pay for automobile liability protection is the fact that automobile casualty insurance risks are classified in accordance with procedures designed to recognize any measurable differences in hazard in order that resulting rates may be adequate, not excessive and not unfairly discriminatory. There are four distinct types of classifications: by territory; by type or construction of the vehicle; by use of the vehicle; and by the record or experience of the insured.

The territorial separation was originally made to distinguish city areas, suburban areas and rural areas. However, by 1919, this had been enlarged by most companies to 116 territories. In 1940 there were 824 territories in the United States for which experience was separately recorded. There has been no appreciable change under the postwar statistical program.

The classification by type of vehicle is now used chiefly to differentiate private passenger, commercial, public and other livery

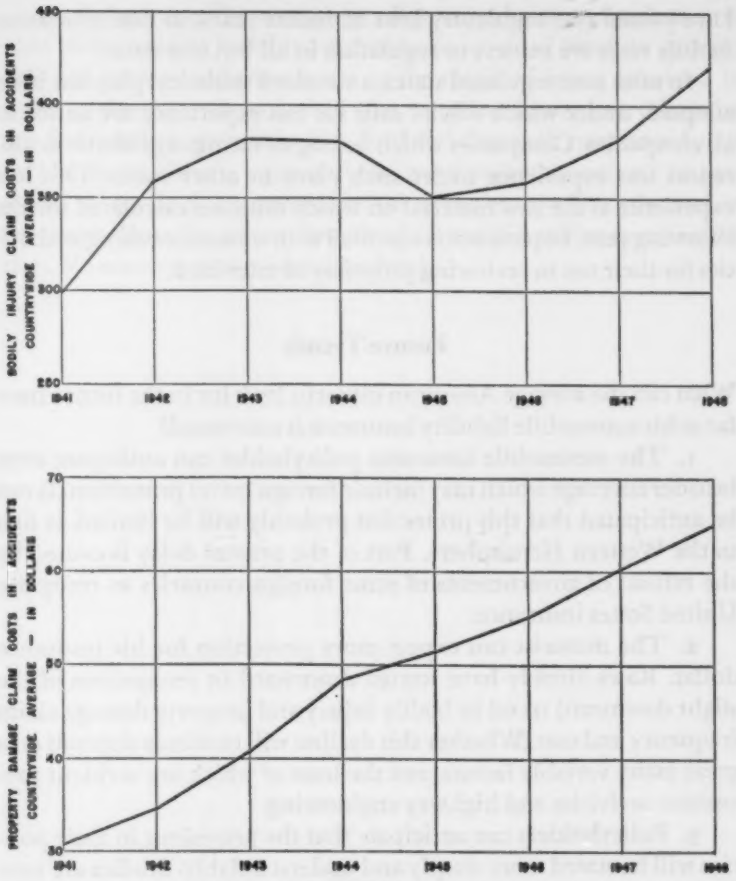


FIGURE 2

vehicles and trailers. Use classifications are applied in all of these type classifications. The record of the insured is now used only in risks which are of sufficient size to justify rating them on their own experience. This applies to fleet operations.

Governmental regulation of automobile insurance has in the past been directed chiefly to requirements of filing and approval of policy forms and endorsements, although several states have regulated rates, rules and rating plans for many years. Additional states

have passed rate regulatory laws in recent years, so that now automobile rates are subject to regulation in all but one state.

In most rate-regulated states, a standard statistical plan has been adopted, under which official calls for loss experience are issued to all companies. Companies which belong to rating organizations also report loss experience under such plans in other states. This loss experience is the raw material on which rates are calculated for the following year. Experience is also filed with state supervising authorities for their use in reviewing propriety of rates filed.

Future Trends

What can the average American motorist look for in the future insofar as his automobile liability insurance is concerned?

1. The automobile insurance policyholder can anticipate even broader coverage which may include foreign travel protection. It can be anticipated that this protection probably will be limited at first to the Western Hemisphere. Part of the present delay is caused by the refusal of governments of some foreign countries to recognize United States insurance.

2. The motorist can expect more protection for his insurance dollar. Rates already have started downward in recognition of the slight downward trend in bodily injury and property damage claim frequency and cost. Whether this decline will continue depends on a great many variable factors, not the least of which are accident prevention activities and highway engineering.

3. Policyholders can anticipate that the provisions in their policies will be stated more simply and understandably. Studies are now underway to simplify insurance contracts for the average private passenger car owner.

4. Americans can look for a continued upward trend, for at least a few more years, in the percentage of licensed automobiles insured for liability. This will be of benefit to everyone, since it reduces the likelihood of becoming involved in an accident with an uninsured vehicle. This is being brought about by adoption of the new type safety (financial) responsibility law by those states still having the old type.

5. Agitation will continue in a few states for state funds to provide motor vehicle liability insurance, or for state funds to provide relief to persons suffering losses as the result of being involved in traffic accidents with motorists who were not insured or otherwise not financially responsible. It is doubtful that such insurance funds will be set up, since it is generally agreed that insurance can't be provided or serviced by governmental agencies as efficiently and as economically as by private insurance companies under state regulation. No state at present has such a fund.

Can We Afford More Accidents?

DAVID M. BALDWIN

Mr. Baldwin is Director of the Traffic and Transportation Division of the National Safety Council in Chicago. As coordinator of his division's activities, he is an authority on traffic problems of cities and states. He was a traffic engineer for the Council for six years before his appointment as division director. On-the-spot analyses of traffic programs have given him first-hand knowledge. From 1937–1942, Mr. Baldwin was a safety engineer for the Virginia division of motor vehicles and the Virginia state police. Previously, for two years, he had been a city traffic engineer in Evanston, Ill. He is secretary of the National Conference on Uniform Traffic Accident Statistics and of the Committee on Accident Records of the President's Highway Safety Conference. He is an associate member of the Institute of Traffic Engineers and of the Highway Research Board. He is co-author (with George E. Miller, chief of the public safety department of the Atomic Energy Commission) of a book entitled, "State Traffic Law Enforcement."

A TOO DRASTIC economy wave could have disastrous effects for traffic safety. Our recent gains—a one-third reduction in the mileage death-rate in the last six years—could be wiped out, if appropriations for safety were substantially reduced.

In fact, only by more efficient use of present funds can we hold our *present* gains, much less hope to reduce the rate *further*.

The nation thus comes squarely against the question of how many traffic accidents we can afford. Eliminating for the moment any humanitarian considerations, current estimates place our economic loss from traffic accidents at $2,000,000,000 a year. It appears obvious that today of all times we are not in a position to pay such a staggering sum *from which we receive no benefits.*

The fact that some states and cities have achieved a rate only half the national average should prove that much of the loss is needless. Sound programs of traffic safety can reduce the rate, and additional expenditures would produce a greater dollar-saving in accidents prevented.

Indeed, there is a *possibility* that the present rate may increase.

It is not expected, and would indeed be a sad commentary on past efforts. On the other hand, more vehicles are being operated more miles each year. The fact that medical science is prolonging life expectancy means that more potential traffic-accident victims are using our streets and highways. This increased exposure could conceivably outstrip our highway capacity and our prevention efforts.

Too, the very fact that the rate has been decreasing might lull both officials and public into complacency—and relaxed efforts. The recent widespread public awareness of the problem will be hard if not impossible to maintain—and the rate could start upward.

Our Knowledge Is Better Than Our Practice

The situation is paradoxical when one considers the present state of our knowledge of traffic safety. We have just completed the second major President's Highway Safety Conference. As a result, we have a group of technical committee reports that lay out a program representing the best traffic knowledge in the country today—the collective thinking of leaders in every phase of the problem. The program developed should, on the basis of experience, be capable of effecting a further substantial reduction in the death rate. At the closing session of the Conference, the nation was challenged to bring the rate down to 5.

As a measuring stick of progress by individual states and communities, we have the Annual Inventory of Traffic Safety Activities, the National Pedestrian Protection Contest, and the National Driver Education Awards Program. Summarizing annually the efforts and accomplishments of states and cities, these yardsticks can and do tell us where progress is being made and where weak spots still exist.

As a highly important means for providing intelligent direction to local safety activities, it is recommended that individual states and communities analyze their own reports and compare them with standards set by the President's Conference Committee reports and by the performance of other states and communities.

With the aid of the recommendations of the President's Highway Safety Conference and these measuring devices, it should be a relatively easy matter to formulate and put into action a sound, well-

rounded program in every state and community. If this were done, we certainly would have no fear for the future. The traffic death-rate could go in no direction except downward.

These same measuring devices, however, show clearly that current traffic safety programs fall far short of these standards. Gains have been made in recent years, and many states and communities are doing outstanding jobs in certain phases. Perhaps the major difficulty lies in the fact that in very few areas has a uniformly high level been achieved. Low levels of performance in many states and cities are weak links in the chain of accident prevention. Through these low spots, trouble may develop in the form of a rising death rate.

Accident Records and Driver-Licensing Weak

Although it would be possible to canvass all the fields—engineering, enforcement, education, public information, and all the others—indicating state by state and community by community where activities and programs were weak, such an accounting would mean little in an over-all sense. Such information is available from the Annual Inventory and other measuring programs. Two fields stand out as generally weak. These are accident records and driver-licensing. Accident records are so fundamental to the success of all other phases of the program that it seems almost incredible not to have given them major attention before now. Driver-licensing, while generally considered merely one tool of accident prevention, is for many of us the "white hope" of traffic safety.

Current weaknesses in the field of accident records are due in part to the absence of any external evidence of the functioning of an accident-records system. Enforcement means officers on the road and courts hearing cases. Engineering means new highways, new vehicles, and new control devices. Public information means newspaper articles, posters, radio messages and movies. But behind the scenes is the accident-record bureau. If it fails to function—as in many cases it does—the whole safety program may be inefficient and ineffective. Yet no one is immediately aware of the source of the failure.

Top-level administrators, who should recognize the value of program direction on the basis of adequate records, have reacted to

public demands for greater safety effort by more of the visible elements—new roads, new signals, more uniformed officers, more posters. This in turn has further subordinated accident records, since less money and less time were available for the records bureau.

Whatever the reason, the deficiencies are all too apparent to a trained observer. Most record bureaus have an entirely inadequate staff. The staff has not been selected on merit; needed training has not been provided. The bureaus have been regarded as bookkeeping organizations, and their analytical purposes have been overlooked. Equipment and facilities have been insufficient. Responsibility for collecting and analyzing accident records has in many states been divided, no strong central bureau being set up. As a result, none of the little bureaus obtains full information. Public funds are wasted by a duplication of processing procedures.

In many areas, reporting practices and collection procedures are so poor that the bureaus must work with a totally inadequate volume of reports. Administrators and other potential users of accident information soon find that data based on such incomplete reporting are either misleading or wholly useless. Some bureaus with a relatively high volume of reporting fail miserably in the task of developing data of use to accident prevention agencies. Too often, the records bureau assumes the job ends with preparing a routine summary. Actually, this is only the beginning: the bureau must analyze and interpret this summary as well as other data.

Driver-Programs Frequently Inadequate

In the field of driver-licensing, a few states have set an enviable record, and others must be given credit for effort. By and large, however, the potential value of a comprehensive driver-licensing and driver-improvement program is not being fully realized today.

In some states, driver-licensing is regarded primarily as a revenue-producing measure. Expenses of administration are kept at a minimum to produce the greatest income. Consequently examinations for new drivers are not given or are skimped. No provisions are made for reviewing the history of drivers with bad records, and suspension or revocation of the driving privilege is seldom used as a corrective or

punitive measure. In such circumstances, drivers cannot be sure that someone in authority is going to be concerned about an accident or a violation, and that the privilege of driving will probably be lost if a serious accident or a violation occurs. Drivers *are* sure of this in states doing an outstanding job of driver-licensing. This state of mind is one of the most effective deterrents to bad driving that can be devised. It accounts in a large measure for the consistently low death-rates in certain jurisdictions.

It is an attitude brought about not by chance but by firm, strict, continuous policy on the part of driver-licensing administrators. Examinations are tough, so that drivers who pass (and by no means all pass the first time) have a feeling of real accomplishment. Records are maintained in accessible form so that the driving history of an individual is complete and up-to-date. Continuous review of this file brings to light all drivers with bad records, and administrative action is sure and prompt. Action may take the form of an interview and re-examination, a warning for first offenders, or a formal hearing looking toward suspension or revocation of the driving privilege.

Driver-Improvement

Too many states fail to take advantage of such a plan particularly in reviewing driver-histories and in treating drivers with bad records. This phase of the program is frequently referred to as "driver improvement," and it is exactly that. Many times an interview with an errant driver will bring about a marked change in behavior. The mere fact that someone has checked on him may work wonders.

In other cases, a short suspension may be necessary and helpful. In many states, however, the only suspensions ever made are those required by statute for serious or repeated violations—driving under the influence of intoxicants, several convictions on the charge of reckless driving, leaving the scene of an accident, or other felonies.

This does not mean that driver-licensing and driver-improvement alone will solve the traffic-accident problem or prevent an upswing in the mileage death rate. It implies, however, that driver-licensing and driver-improvement are considered one of the most effective weapons against accident and death—a weapon not always used to the fullest extent.

Non-Uniformity and Other Weaknesses

Weaknesses are apparent in many other fields, but they are not as common as in accident records and driver-licensing. By no means all states and cities have adopted the provisions of the Uniform Vehicle Code and the Model Traffic Ordinance, thus delaying the creation of a nation-wide similarity of laws helpful to drivers and officials alike. Traffic engineering is still relatively new in many states and communities. Only recently has the traffic engineer been given a position of real authority in many state highway departments or city governments. In even fewer jurisdictions is the traffic engineer provided with a budget sufficient to carry out more than a few of the improved design and control features he knows would reduce accidents.

Perhaps because enforcement provides the easiest method to make a quick reduction in accidents, traffic policing is further along than many of the other fields. Many departments, however, are still woefully under-manned. There are still areas in which traffic problems are considered a necessary evil with which the police must deal in time left over from their "regular" police duties.

Some of the greatest gains in recent years have come in the traffic court. Much of the improvement here stems from the publication several years ago of George Warren's report on "Traffic Courts." Interest of the American Bar Association and of many other national groups has contributed materially to improvements effected. Much remains to be done. A tribute in passing is due the new program for traffic courts in New Jersey. Whether or not it will prove a pattern for other states remains to be seen, but in any event it represents a milestone in the administration of justice.

School Programs

Most elementary schools are devoting attention to pedestrian and bicycle safety. A progressively better accident record for elementary school age children would appear to indicate that this program has been successful. On the other hand, the poorer accident experience of the high school and college *age groups* suggests that the elementary school program may be protection rather than education.

Driver-education in high schools has made substantial gains in

recent years. Still, only about one-fourth the eligible high school students receive this training. Accurate figures on the number receiving "behind-the-wheel" instruction are lacking, but the number is undoubtedly substantially below this 25 per cent figure. Much more needs to be done.

Education of the general public through a public information program is likewise spotty. Despite increasing cooperation on the part of public information media, direction of the program by state and city officials has in many areas been completely lacking. There is, however, a growing awareness of the need for this type of effort. The acceptance of national programs such as the "Operation Safety" program of the National Safety Council is encouraging.

Primarily an Official Responsibility

The discussion so far has been based on the logical assumption that the primary responsibility for traffic safety is an official responsibility. Elected and appointed officials, legally charged with protecting life, limb and property, have the power to act. This does not minimize the contribution that individual citizens can and must make to the program—both as walkers and drivers, and as supporters of these officials.

In the final analysis, the safety record of a community depends upon the individual safety of those who use its streets and highways, and the efforts of official agencies depend to a great extent upon the interest of and support given by individual citizens. Few officials are willing to venture far ahead of public opinion. In many cases, public opinion is far ahead of official action.

Two Great Weaknesses

In all the official endeavors described above, two great weaknesses crop out again and again. These are the lack of trained and competent employees, selected on merit and retained on merit, and the absence of financial support to enable the administrators to do their job well. In accident records, in driver-licensing, in enforcement, in engineering, in safety education, in public information—in all

the official fields, good personnel and adequate finances are crying needs. They can be had, but usually only as a result of an expression of the will of the public, as evidenced by their support of the administrator and his program.

Perhaps no phrase has been abused as much in recent years as "public support." Much of the misconception about public support exists because the term has been so poorly defined. Not even the National Committee for Traffic Safety, the organization designated by the President's Highway Safety Conference to coordinate public support of activities at the national level, has succeeded in finding a definition. Currently their newsletter is attempting to develop such a definition. Some attempts have been made to define it in terms of public acceptance of a traffic safety program.

A Definition of "Public Support"

To me, public support means much more than mere public *acceptance*. It means public *insistence* upon an adequate, effective traffic safety program. It means public support at the polls for legislators and officials who provide such a program. It means public willingness to pay sufficient taxes to accomplish the traffic safety job as it should be accomplished.

This is quite a different concept from that held by some public officials, who have the idea that public support means having the public tell them how they should run their business. Naturally enough, these officials do not like that kind of support. The broader concept of public support should appeal to all officials who want to do a good job. Public support in these terms can produce needed personnel and financial support. It can make the task easier for the public officials now working for public safety, and it can spur them on to greater efforts.

Public support is more than public opinion. The latter is a passive thing—public support is active and militant. Public opinion already favors traffic safety—for no one favors accidents. Active and militant support, however, has by no means been achieved throughout the country. There are isolated examples, it is true, of public support groups that have been successful in their endeavors. On the

national level, the National Committee for Traffic Safety has accomplished much in the few short years of its life. By and large, however, public support of an effective nature has not been developed.

The development or stimulation of public support is a complicated and technical job. Within a community, the key is usually found in an individual who has the respect of the community and who will spark the program. All the time-honored stunts and promotional schemes of the publicity and public relations fields may be brought into play to arouse and maintain interest.

Basically, the public must be convinced of the need for their participation and of the contribution which their interest and help can make. The public must be given a program to support—either a going program producing results, or a proved program (on paper, perhaps, as far as their community is concerned) to take the place of a nonexistent or lackadaisical program now current.

In either case, the program must be explained and the advantages put in terms that average citizens can understand. If this is done, citizens' support can be secured, and the program can go forward. Without this active support, the responsible public official has little incentive and may have much opposition from selfish groups. Public support thus becomes a key-stone of the traffic safety program.

The Saving in Lives and Dollars

The decision is ours—and now is the time. We can go forward to a lower mileage death rate, a rate of 5 or even lower. Or we can face the prospect of a continued rate of 8—or higher. The difference between the two—at 1948 travel levels—is 12,000 lives and nearly half a million injuries. This is no small reward for applying the knowledge we have.

The saving will be high in terms of humanitarian benefits, the cost low in a businessman's terms of dollars and cents. The 12,000 deaths and accompanying non-fatal accidents that will *not* happen represent an economic saving of nearly $800,000,000. If the cost of the increased efforts were $80,000,000—a most generous allowance—the nation would benefit by $720,000,000. That is economy of a sort that every citizen and taxpayer understands and wants—today more than ever. We *can* afford traffic safety.

As officials, we could study our own programs, determine the weak spots, and raise our standards to levels of highest performance. The pattern is clearly set forth in recommendations of the President's Highway Safety Conference. The measuring sticks are available.

We could develop the latent public support reflected in a universally favorable public opinion—a public support that will make it possible to set and maintain these high standards. Help is available in the experience of states and communities that have done the job already. A first step is to create a program that *can be supported.*

As non-officials, we can encourage officials to adopt higher standards. We can individually, and as members of organized groups, tell officials that we favor the traffic safety program. We can prove it at the polls, at the tax collector's office, and at the wheel of our cars. We can accept the traffic safety program—as it affects ourselves and others—but we can work for it too.

If we don't do this—if we as officials say that the current state of affairs is good enough . . . if we as laymen say we're "for safety" but we aren't willing to work for it . . . the result will be increased suffering, increased loss.

There can be only one choice.

Traffic and Parking in Suburban Shopping Center Development

SEWARD H. MOTT AND MAX S. WEHRLY

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Mr. Wehrly is Assistant Director of the Urban Land Institute. Previous to his connection with the Institute, he was City Planner of the National Capitol Park and Planning Commission of Washington, D.C., where he was in charge of the Comprehensive Plan Preparation, thoroughfare, land use, and zoning studies. He is author of articles on planning, zoning and subdivision control, and co-author with A. C. Comey of "A Study of Planned Communities." He is a member of the American Institute of Planners, and a citizen member of the Arlington County, Virginia, Planning Commission.

WITHIN the last twenty-five years a revolution has quietly been taking place in the field of retail merchandising. To a considerable degree, it has been brought about by the American citizen's increasing resistance to walking.

Encouraging this resistance has been the revolution in transportation permitting a luxurious freedom to move on wheels to destinations of the citizen's own choosing.

Almost, that is. In recent years, this freedom has been curtailed in central parts of our cities—in more or less direct proportion to the increased automobile traffic that tries to get there. In other words, our central business districts have become less and less accessible.

Accessibility is a key factor in most forms of retail merchandising. Relatively few types of merchandise can be brought directly to the consumer's door. The modern outlying shopping center has, however, gone a long way in bridging this gap in two respects; first,

through proximity to the consumer on a sectional and local neighborhood basis; second, through its accessible location on adequate highway approaches, with the provision of ample off-street parking facilities.

Primarily, the success or failure of a suburban shopping center will depend on the size and buying power of its tributary area in terms of people and dollars. If this is inadequate, good accessibility is of little value. On the other hand, many centers have failed to realize their full potential because of deficiencies in location, highway approaches and parking accommodations.

Location

Location on, or immediately adjacent to one or preferably more, major traffic thoroughfares is a primary requisite for the major shopping center. Unlike the purely local neighborhood center, it must depend on a large trade area that may approximate roughly, eight to ten square miles or more, of developed residential area. The local center of ten to twelve service shops, on the other hand, will often serve its functions to the best advantage if located with reference to one or more secondary streets serving a neighborhood of not fewer than five hundred to a thousand homes.

Much can be said for keeping the small center compactly located on one side of the highway, and, if properly designed, it need not exert an adverse effect on the opposite frontage. Small-store centers divided by thoroughfares not only are weaker from a merchandising standpoint, but generate pedestrian traffic across the highway that is undesirable from a traffic point of view.

No fixed rule can be formulated as to which side of the street is the better. Conditions vary with the individual location. However, a location between the major potential buying power and the central city is preferred. Patronage originating from the home tends to gravitate cityward toward a center, rather than countryward. Also, a considerable amount of pick-up and quick shopping is done by the homeward-bound wage earner. Thus, a center that conveniently serves his requirements enroute is desirable. A location on the "going home" side of the street, and cityward of the trade area served, is usually favored under these conditions.

Amount of Walk-in and Drive-in Trade

It is doubtful that any center can develop its full potentialities without providing for a certain amount of walk-in trade. The degree to which it will occur depends on several factors. In general, the small neighborhood center has, and will continue to have, a high percentage of walk-in trade.

Adjacent apartment development will increase this substantially, as will a trade area composed of modest or low income groups where the ownership of one car is the rule, often used by the breadwinner. On the other hand, a single family home development of middle and upper income families, often with two cars or more, may raise the parking requirements materially. The basis for this determination can only be reached with reasonable assurance by market analysis studies for the center in question.

Large sub-centers, on the other hand, will obtain a relatively high proportion of their trade from drive-in patrons. It thus becomes increasingly important to provide the optimum amount of off-street parking if these centers are to realize their potential trade volume.

Experiments in Shopping Centers

Recently, there have been several proposals in the shopping center field which depart in a number of respects from what has been outlined above. The so-called "auto-shop," developed in Chicago, contemplates, in addition to the usual parking facilities, direct automobile access to pick-up windows for packages and sales windows where purchases can be made directly from the car for certain types of non-selective merchandise.

Experience in auto-shopping has, so far, been confined largely to such items as gasoline stations, which are obviously suited to this technique, curb-service eating places, and drive-in banks. Experience with drive-in banks has been inconclusive. In several cases, banks that have provided drive-in facilities at considerable expense, have since abandoned them. One of the reasons advanced for their failure is the lack of personal contact between customers and bank officials.

Large "regional" centers, lying in the open country between centers of population and adjacent to major highway routes, have been projected recently. One of the factors in this type of location appears to be low land-costs. However, when the value of land is compared with the total cost involved, the validity of this factor appears to be questionable. These projects also make no apparent provision for any kind of walk-in trade. While it is, of course, evident that no pedestrian trade will develop until such time as the surrounding area has been built up, it is doubtful if this feature can be disregarded over a period of years.

The size of these projected centers, with relation to the distance to be traveled by the shopper from the parking area to the store, also becomes increasingly important. While walking distances up to 1000 feet have been considered feasible in the downtown areas of large cities, there is a definite resistance in outlying centers to parking that requires a walk of more than 300 feet. One large project on the west coast, where parking facilities extend more than 500 feet distance, is contemplating the installation of small open shuttle buses to transport shoppers to and from the stores.

These departures in shopping center development should be watched with interest.

The Site

Generally speaking, the modern shopping center of minimum size will require from ten to twelve stores on a site of three to three and one-half acres in order to develop the potential purchasing volume of 500 to 1000 families of average income. On the average, suburban shopping centers will require at least one acre of site per 1000 persons (about 300 families). The Community Builders' Council of the Urban Land Institute recommends the following stores as the first ten which, under normal conditions, should be found in a small center. Variations will, of course, occur depending upon the local situation.

1. Drug Store (with some eating facilities)
2. Cash and Carry Grocery
3. Cleaner and Dyer shop which could be combined with a laundry agency

4. Beauty Parlor
5. Filling Station
6. Bakery (this might depend on bakery provided by supermarket)
7. Shoe Repair—possibly in rear of another store or combined with cleaner and dyer
8. Laundry Agency—possibly in rear of another shop or combined with cleaner and dyer
9. Variety Store—possibly on a temporary basis
10. Barber Shop

These data should, of course, be considered as a guide rather than a standard.

Parking will occupy the major portion of the shopping center site. The ratio of site to amount of retail floor space has been steadily increasing. A decade ago, a ratio of 1 square foot of parking to 1 square foot of floor area was considered adequate. Today, the forward-looking shopping center developer would not consider less than a ratio of two square feet of parking area to 1 square foot of retail store area, even where substantially more than 50% of the trade is walk-in.

In centers which depend on higher percentages of drive-in trade, ratios up to three and even four to one are not excessive. Studies of the Urban Land Institute indicate a considerable variation in the number of cars accommodated on a given area in various centers. This is principally because of the size and shape of the site and car stalls, method of parking, and the efficiency of the site plan. A better approach to parking adequacy is that of car spaces per 1000 square feet of retail space.

Thus, an efficiently designed center will provide about seven car spaces per 1000 square feet on a two to one basis, or ten spaces per 1000 square feet on a three to one basis, with due allowance for pedestrian walks, service areas, and planting.

Parking Arrangement

There is considerable difference of opinion regarding the best layout and arrangement of parking areas. Actually, there is no best method. The optimum arrangement will vary with the type and size of center,

shape of the site, and of no small importance, the customs and habits of the locality.

In general, parking areas should be located with reference to (1) easy accessibility and visibility from the highway; (2) convenient and close access to the shops; and (3) the peak and base hour shopping load. This latter consideration is most important.

Peak periods may represent only 15 to 20 per cent of the total number of store hours each week. Consequently, to provide all the parking space on the highway side of the stores will not only set the buildings and store fronts back an excessive distance, but will present a large foreground of unoccupied and unattractive pavement to the passing motorist. Conversely, if no front space is provided in the interests of window display, the motorist is discouraged in seeking a parking space, especially if rear parking is not readily discernible.

Extensive studies on this subject have led the writers to the conclusion that, in general, not less than two nor more than four tiers of parking should be located on the highway side of the shops to accommodate the normal base day trade.

While the arrangement of buildings is not considered here, it should be pointed out that the most remote parking space should rarely, if ever, exceed a distance of 300 feet from the nearest store. Some large sub-centers are already experiencing considerable resistance to use of parts of their parking areas because of the distance factor.

Access

Ingress and egress, to and from adjacent streets, should be physically defined and the parking area physically separated from the adjoining streets. This is advantageous both for the shopping center and highway traffic. Points of access, with respect to the shopping center parking area, should be so located that no back-tracking of cars will be necessary. Stub or dead-end areas are undesirable. This may require more access points to the adjacent streets than the traffic engineers would like. It should be pointed out, however, that during peak trading hours, the presence of additional connections into the parking area can help materially in getting this traffic off the highway, instead of concentrating it at one point. On limited access

highways, border service roads giving direct access to the center should be provided. On normal highways, the most critical point of access is at or near the intersections. It is undesirable, for instance, to locate entrances or exits so close to an intersection that they interfere with moving traffic on the one hand, or are blocked by halted traffic at the stop light on the other. As a rule, an access point should occur on the far side of the intersection, unless it can be well removed from the corner.

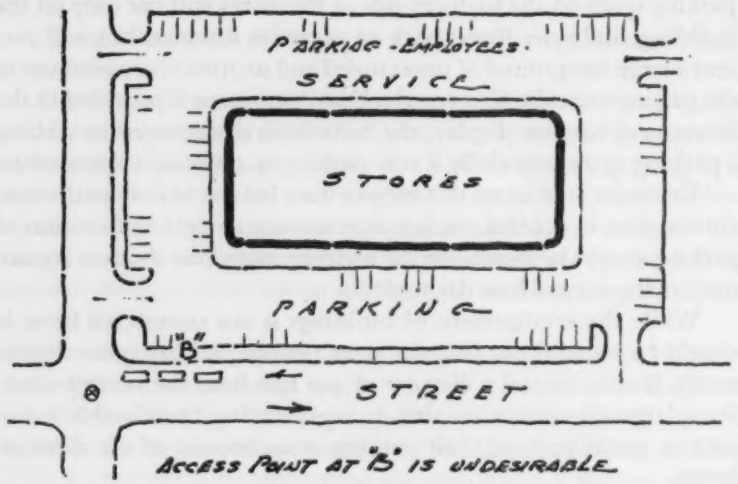


FIGURE 2

Parking Stalls

In general, head-in or 90-degree parking is recommended. Principal advantages are economy of space and greater flexibility of two-way movement within the parking area which permits cars to select the nearest parking space and the nearest exit. It should be emphasized that the suburban shopper expects and should get considerably more spacious parking accommodations than can usually be provided in downtown locations. Eight and one-half to nine-foot wide parking bays are becoming increasingly necessary with today's wide cars and car doors. This is even more important where cash and carry packages are stored in the back seat by Mrs. Housewife.

For head-in parking, a 60–65 foot bay is recommended which provides for two tiers of parked cars with a two-way center aisle which permits easy maneuvering. If one-way, diagonal parking is to be used with more than two tiers of cars, the herring-bone arrangement is the most economical of space as the overall bay width can be reduced to as little as forty-five feet, although fifty feet is recommended.

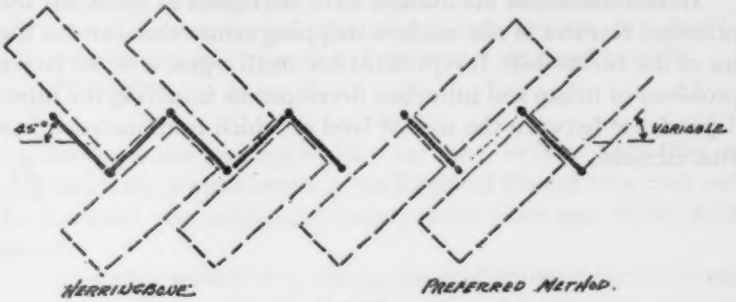


FIGURE 1

The herringbone arrangement of necessity requires a 45-degree angle, while the preferred modification in Figure 1 can be adjusted more readily to site limitations.

In general, where the depth of a parking lot exceeds two bays, the bays should be oriented at right angles to the store group, if possible, in the interest of pedestrian convenience. While a walk-way can be provided between the tiers of parked cars, it should be at least 6 to 8 feet wide in order to accommodate car overhang and encourage its use as a pedestrian way. Many developers feel, however, that the advantage gained is insufficient to justify the area lost in parking.

Special Purpose Parking

The arrangement of shops by types of business in a center is outside of this discussion. It has, however, a direct bearing on the arrangement and location of parking. Theaters, for instance, should never be located in the middle of a shopping center. One of the reasons is that parking areas are thus preempted that should be free for the shopper, particularly where the theater holds matinees and the stores

have evening hours. A side location, with side or rear parking separated from the shopper, is preferable. The same applies to bowling alleys and similar places of assembly. Employee parking should be relegated to the least desirable locations within the center. It has been estimated that one employee's car can occupy the space all day which would otherwise be available for as many as 5 to 8 shoppers.

In this discussion the authors have attempted to point out the principal features of the modern shopping center that involve the use of the automobile. It represents one small segment of the larger problems of urban and suburban development involving the interdependence between the uses of land of which transportation is a vital element.

Metropolitan Planning

C. MCKIM NORTON

Mr. Norton, formerly a practicing attorney in New York City, was counsel to the National Resources Planning Board in 1939. Since 1940 he has been Executive Vice-President of the Regional Planning Association, Inc. He is a Director of American Institute of Planners and American Society of Planning Officials. In 1945 he served as legal advisor on land planning to the President of the Philippines.

ADDRESSING the meeting of May 10, 1922, in New York City, at which the project known as the Regional Plan of New York and Its Environs was announced twenty-seven years ago, Elihu Root stated:

"A city is a growth. It is not the result of political decree or control. You may draw all the lines you please between counties and states, a city is a growth responding to forces not at all political, quite disregarding political lines.

"Now, growth can be directed, just as trees can be trained and pruned and made to grow this way or that; if they are wanted for particular purposes they can be adapted to those purposes. This project is to get an intelligent idea of how the growth of this city in the future may be directed, with common and general judgment about the way in which it is desirable that it should grow, so that it will meet as fully as possible the difficulties that are inseparable from mass human life. I think the project is practicable. I think that the existence of plans known to everybody will give just enough direction to the movement of the multitude of separate impulses to lead the growth along the right lines."

These two paragraphs sum up two of the basic concepts of metropolitan area planning: *first*, that the metropolitan region is an economic and physical area made up of a number of political units—in the case of the New York Region parts of three states, 22 counties and 548 independent municipalities; *second*, that metropolitan plans based on an understanding of metropolitan trends and needs, are necessary so that direction will be given to the "multitude of separate

impulses" of real estate developers, highway builders, school boards, mortgage lenders, legislators and the host of others who cumulatively build urban areas.

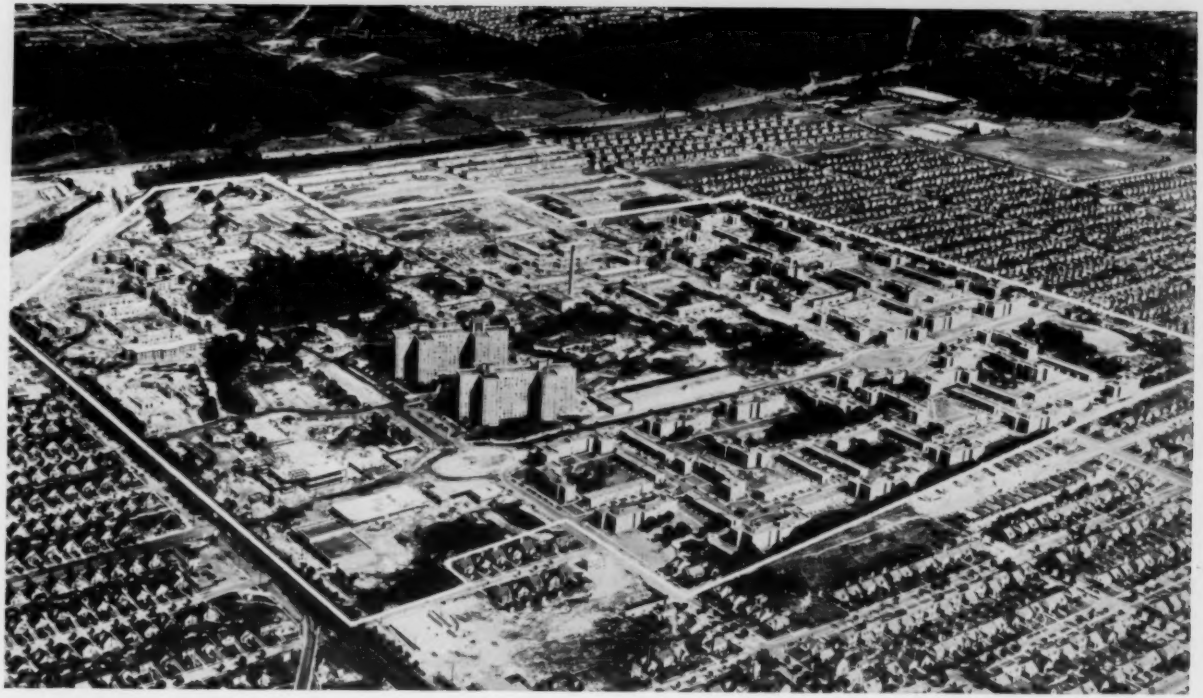
Metropolitan planning was a new concept in 1922 when the Russell Sage Foundation invited leading citizens to meet and discuss "the problems created by the concentrations of population in and about the City of New York"—an area extending approximately 50 miles from New York's City Hall. Since that date, metropolitan planning has been carried on in urban concentrations centering on Boston, Chicago, Philadelphia, Cleveland, Grand Rapids, Kansas City, Louisville, Buffalo, Pittsburgh, San Francisco, St. Louis, Springfield, Ohio and Toledo.

Value of Plans 'Known to Everybody'

In all cases, the work has been carried on by private citizens' organizations rather than by public agencies. The reason for this is that official planning agencies can only be organized by units of government, and there are no examples of metropolitan government in the United States. There has been planning for, and operation of specific functions (such as bridges, tunnels, sewer and water supply systems) on a metropolitan basis by agencies like the Port of New York Authority or Metropolitan District Commissions in the Boston area. But full-scale plans for metropolitan areas have been, and will continue to be, developed and fostered by citizen organizations at least until municipal government catches up with the growth of urban areas.

The Regional Plan of New York and Its Environs was published in 1929 after seven years of research. This plan contained public works proposals for arterial highways and parkway systems, an airport system and a system of large parks. In the intervening 20 years, a large majority of these proposals have been carried out. Putting it another way, practically no major developments in these fields have been built which were not projects in the Regional Plan of highways, parkways, airports and major parks.

The value to public officials of such "plans known to everybody" is that it has given "just enough direction to the movement of the



Fresh Meadows Project, Queens County, New York: apartments, stores, school and recreation areas in one super-block.

multitude of separate impulses to lead the growth along the right lines" as Elihu Root predicted a quarter century ago.

There Are Also Legal and Social Concepts

Metropolitan planning, however, involves more than creating a shelf of public works. Important to the growth of a metropolitan area as are its transportation and recreation systems, these are but the skeletal framework around which the private development of the region is built. Legal and social concepts worked out by the Committee on the Regional Plan of New York and Its Environs have been as influential as the spectacular engineering plans brought to reality in such dramatic fashion by the tunnels and bridges that connect Manhattan with New Jersey and Long Island, and the region's expressway, airport and park systems. These legal concepts included drafts of zoning and planning legislation prepared in the mid-20's, adopted and publicized by the U.S. Department of Commerce under the leadership of Herbert Hoover, then Secretary of Commerce. These drafts became the standard planning enabling legislation now adopted in virtually every state.

The social concepts included some of the first standards for recreation areas required for given units of population, first principles of large-scale redevelopment of blighted urban areas and the neighborhood unit principle. These standards and principles have been translated into realities in city and county park systems, urban redevelopment legislation and a neighborhood unit such as the New York Life Insurance Company's Fresh Meadows project in Queens County, New York, which provides different types of residential apartments, stores, a school and recreation areas all in one superblock.

Wherever there has been active metropolitan planning, it has been accompanied by active local municipal planning and zoning, and, of recent years, county planning. Indeed, one of the basic principles of any citizen metropolitan planning agency, such as the Chicago Regional Planning Association, the Cleveland Regional Association or the Regional Plan Association operating in the New Jersey–New York–Connecticut metropolitan area, is the promotion

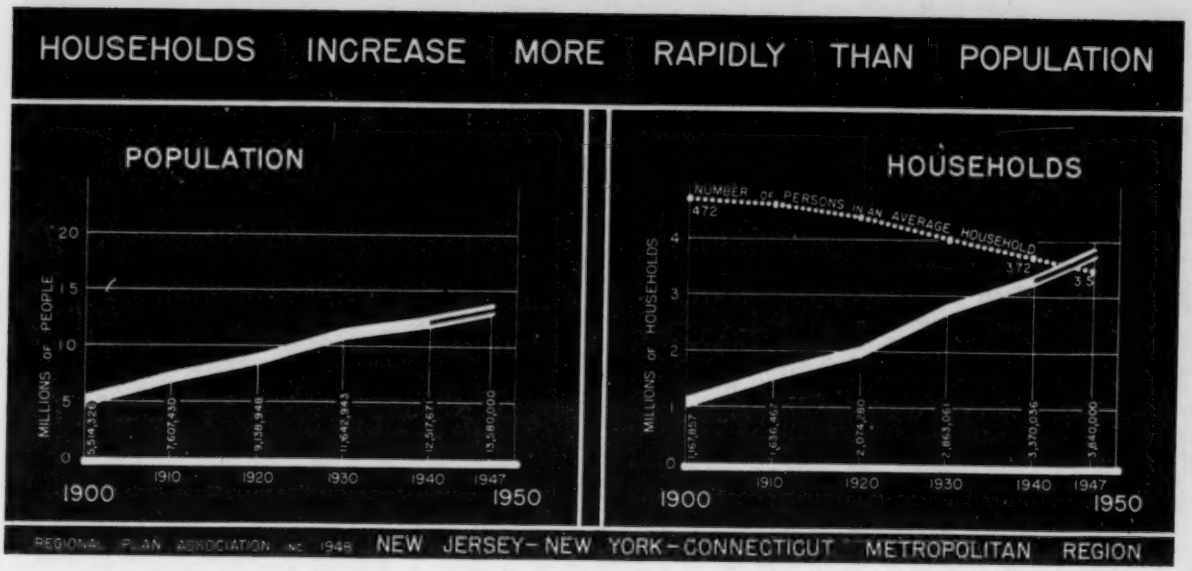

HOUSEHOLDS INCREASE MORE RAPIDLY THAN POPULATION
POPULATION
MILLIONS OF PEOPLE
0
5
10
15
20
5,514,326
7,607,430
9,138,948
11,642,943
12,517,671
13,580,000
1900
1910
1920
1930
1940
1947
1950
HOUSEHOLDS
NUMBER OF PERSONS IN AN AVERAGE HOUSEHOLD
4.72
3.72
3.5
MILLIONS OF HOUSEHOLDS
0
1
2
3
4
1,167,857
1,635,467
2,074,780
2,863,061
3,370,036
3,840,000
1900
1910
1920
1930
1940
1947
1950
REGIONAL PLAN ASSOCIATION INC. 1948
NEW JERSEY–NEW YORK–CONNECTICUT METROPOLITAN REGION

FIGURE 1

and encouragement of local planning guided by the experience and information gathered by the regional agency.

At this time there are still vital large-scale public works that must be built in the metropolitan areas—flood control projects, trunkline sewers, water supply projects, expressways, for example. Equally

THE OUTER PARTS OF THE REGION ARE GROWING FASTER
EACH FIGURE REPRESENTS 100,000
ADDITIONAL POPULATION 1940-1947
NEW JERSEY-NEW YORK-CONNECTICUT METROPOLITAN REGION

FIGURE 2

urgent, however, and less recognized, is the need of a better understanding on the part of citizens and officials, especially officials of local government, of metropolitan trends of development.

Five Factors in Metropolitan Expansion

The built-up sections of metropolitan areas are expanding in extent much more rapidly than is generally realized. The New York Region (including Northern New Jersey and Southern Connecticut) expanded its closely developed residential areas from 356 square miles in 1925 to 556 square miles in 1940. In other words, the extent of urban development in this metropolitan area during the fifteen

years prior to 1940 increased 56 per cent over its entire built-up area of the preceding 300 years. If this rate of expansion continues during the next three decades (1940–1970), it is estimated that the built-up area of the New York Region may be double its 1940 extent. Should this estimate seem extreme, a motor trip through present-day Nassau County, N.Y., or Bergen County, N.J., will prove an enlightening experience.

What are some of the factors causing this rapid territorial expansion of the New York Region, an expansion which is being matched by other metropolitan areas throughout the nation?

First, the number of people in each American household has been steadily declining since 1900. This means that it takes more homes to house a given population every year. During the 15-year period mentioned above, for example, when the built-up area of the New York Region increased 56 per cent, its households increased 44 per cent, its population only 26 per cent.

To illustrate this point another way, cities, such as Poughkeepsie, N.Y., or Irvington, N.J., which declined slightly in population between 1930 and 1940, had more households in 1940 than in 1930.

Second, there is a desire for more residential space per family both in central cities and in suburban areas. This is exemplified by the fact that about 58 per cent of all new dwellings built in the New York Region since 1940 were single family homes. In 1940 only 28 per cent of all dwellings in this region were single family whereas today this proportion has increased to 31 per cent.

A result of both of the preceding factors is that in five of New York City's six "commuter areas" from five to 55 miles from City Hall, the number of persons per acre of closely developed areas was less in 1940 than in 1925 although each of these areas gained substantially in population. One such "commuter area" (Long Island) retained the same average density of persons per acre during this period. The central area (0–5 miles from City Hall) lost population and declined in number of resident persons per acre.

Third, improved transportation has made suburban areas increasingly available to central city workers. In the New York Region, for example, the 17 counties surrounding the City of New York increased in population 14 per cent while New York City

increased 4.6 per cent from 1940 to 1947. In the same period, persons entering Manhattan south of 61st Street on a typical business day have increased almost 500,000.

Fourth, industry and business, because of improved transportation and other technological factors can now locate in suburban areas

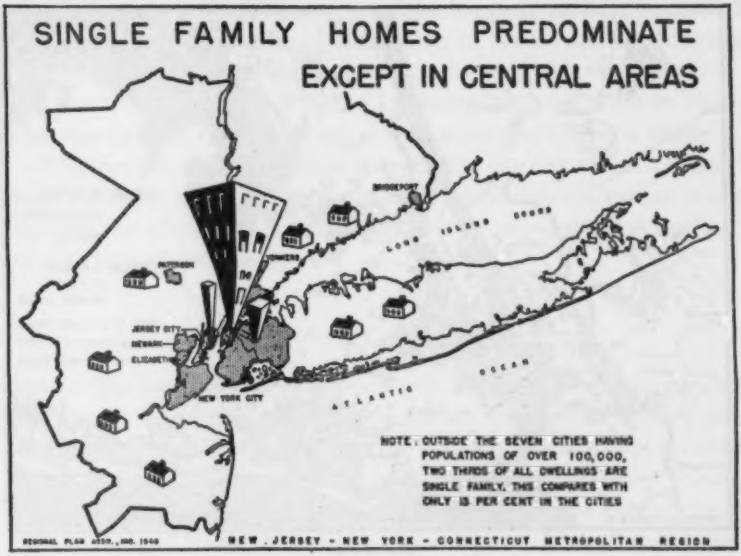

SINGLE FAMILY HOMES PREDOMINATE
EXCEPT IN CENTRAL AREAS
NEW YORK CITY
NOTE: OUTSIDE THE SEVEN CITIES HAVING POPULATIONS OF OVER 100,000, TWO THIRDS OF ALL DWELLINGS ARE SINGLE FAMILY. THIS COMPARES WITH ONLY 13 PER CENT IN THE CITIES
NEW JERSEY - NEW YORK - CONNECTICUT METROPOLITAN REGION

FIGURE 3

once regarded as exclusively "bedroom towns" for central city workers.

"Since 1889, there has been a trend of industries away from central cities to areas on the periphery of those cities in most of the largest industrial areas in the United States. In 1889, 75.6 per cent of the factory wage earners in the New York Industrial Area were working within New York City. By 1909 this percentage of the area's workers in the City had declined to 67.5 and by 1939 to 60.4 per cent.

"Equal or greater declines took place in other central cities. The City of Chicago had 92.1 per cent of the factory workers of its industrial area in 1889, and only 72 per cent in 1939. Philadelphia had 80.7 per cent of the workers in its industrial area in 1889, but by

1939 it had only 61.1 per cent. The proportion of the workers in the Detroit industrial area employed in the central city declined from 90 per cent in 1889 to 58.6 per cent in 1939, and in Los Angeles the drop was from 90.8 per cent to 54.8 per cent in the same period. Only the City of Boston, which has been the nucleus of a contiguous mass

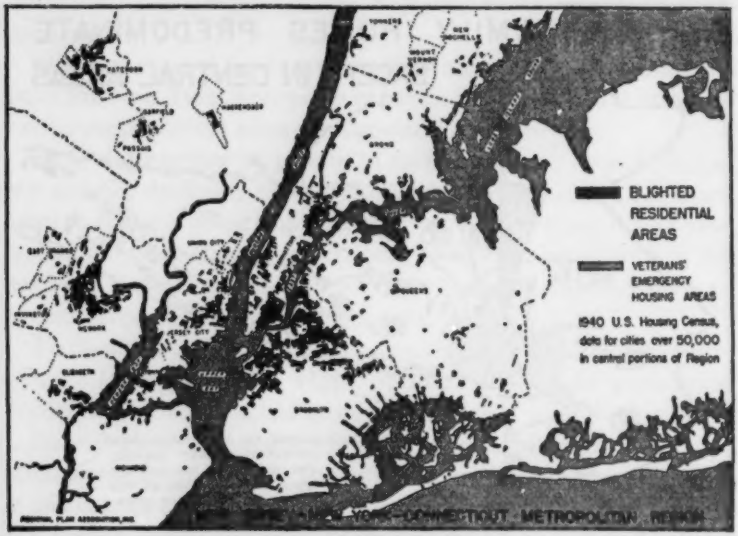

BLIGHTED RESIDENTIAL AREAS
VETERANS' EMERGENCY HOUSING AREAS
1940 U.S. Housing Census, data for cities over 50,000 in central portions of Region

FIGURE 4

of adjoining cities for a considerable period of time showed no decentralizing industrial drift, but it had only 23.6 per cent of the factory wage earners of its area in 1889 and only 24.4 per cent in 1937."[1]

Fifth, in addition to the factors mentioned above, obsolescence of older residential areas has given rise to a mass exodus of residential population from central city residential areas. Between 1925 and 1940, for example, over 500,000 resident persons left the central areas of the New York Region (including North Jersey cities.) These areas which declined in population correspond closely to the so-called blighted, sub-standard or slum areas. They will be slowly rebuilt as Federal and State redevelopment programs get under

1 Economic Status of the New York Metropolitan Region in 1944. Regional Plan Association, Inc., p. 38.

way, but it is unlikely that they will be redeveloped as intensively as they were developed in the first instance. The Williamsburg housing project in Brooklyn, N. Y., for example, completed in 1938 replaced 2,034 ramshackle dwelling units with 1,622 modern apartments.

While some postwar central city housing projects have increased densities of development, the fact is that in New York City during 1947 and 1948 the average density of all new residential construction was lower than the density of existing built-up areas in 1940. This was true for each Borough as well as for the City as a whole.

Whether the figures for these two years in one city reflect a general trend or not, it is generally agreed that urban redevelopment is not expected to affect the long-term extent of expansion of built-up sections in outlying areas.

Two General Policy Proposals

Against the background of these trends, decisions by public officials and private developments must be made. Two general policy proposals may be made at this time. One is that suburban communities should so direct private and public development by planning, zoning and subdivision control procedures that they are not overwhelmed and submerged by the coming developments which will spring into being to meet the demands of increased commuter and locally-employed population. In many instances this may require joint planning by groups of suburban municipalities which individually are too small in area or not financially able to plan for and control their future. Such a program has been instituted by six municipalities in Northern Westchester County with the advice and guidance of the Westchester County Planning Commission.

The other general policy is that central city redevelopment must be so carried out as to avoid the greatest mistake of the past—overcongestion. This means, in most instances, the scaling down and leveling off at public expense and as a public loss the land costs in the blighted central areas which reflect existing congestion. The recently enacted Federal housing legislation provides for grants in aid of this very purpose.

More Intensive Research and Planning Need

In order to be of practical value to public officials and legislators who must make decisions to build expressways, to provide offstreet parking terminals, to reserve and develop park areas and airports, to anticipate sewer and water supply needs, (to cite a few of the public improvements of metropolitan scale which must be built during the next two decades), metropolitan planning should be carried on more intensively than is the case today in most metropolitan areas.

To mention three examples, research and planning for *industrial locations* is needed since the future location of basic employment is a key factor in determining the kind of metropolitan development we shall have—whether it will be largely based upon commuting to work at a few central areas, or whether it will depend upon a larger measure of employment to places of residence.

Continuing study of *population* trends including household composition and location is essential since the future number, type and distribution of families in every metropolitan area will largely determine the amount, type and location of housing, retail stores, water supply, sewage, transportation, highways, recreation and other required facilities which must be provided.

Metropolitan areas require studies of their *transportation* systems including mass transportation systems as well as highway, parkway and freeway systems in the light of changes in industrial locations and population trends. In the New York Region in commuter passenger use alone, much of the system appears to have reached capacity and no long-term solution for this problem can be worked out without a better understanding than we have today of the long-term demand for and the long-term costs of increased commuter facilities.

In his address quoted at the beginning of this article Elihu Root also said:

"The force from which that (city) growth comes is the force of individual enterprise based on a desire for movement, the desire for a living, for wealth, for comfort, for society, all these desires existing in the hearts and acting on the minds of a vast number of units . . . . .

"Those are the forces that build up a city. The individual human

beings, in response to whose urge cities grow, never think about the conditions that are to be created by the bringing together of a great mass of other people like themselves. If we build a house, we build it in what we think is a convenient and a comfortable, pleasant place to have a home. A thousand others, ten thousand, a hundred thousand, all have the same idea, but nobody thinks about the water supply; nobody thinks about the sewage; nobody thinks what it is going to cost to deliver coal there; nobody thinks how far it is going to be from market; nobody thinks about the multitude of difficulties that are created by a great aggregation of human beings into a small territory."

If metropolitan areas are to be developed wisely so that they are efficient and beautiful places in which to live and work, metropolitan research and metropolitan planning are essential.

Those who survey the forest perform no less vital a function than those who hew the trees. Metropolitan planning is 25 years old in the United States. Literally millions of our people are pouring each decade into urban centers from rural areas. There are about one million more persons living in the New York Region today than lived there in 1940, for example.

Metropolitan planning will be needed more during the next quarter century than ever before to guide both the advancing territorial expansion into suburban sectors and the coming redevelopment of central cities. We still need "plans known to everybody" backed by public opinion and brought to reality by energetic public servants and the forces of private enterprise.

A Case Study of One-Way Streets

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The Eno Foundation

MODERN automotive traffic, while capable of free and uninterrupted movement, is generally stagnated in most urban areas. On many city streets, motorists spend more time standing than moving. Average speeds not exceeding a normal walking rate are common. The consequences are numerous: because people attempt to avoid congested districts, old, established businesses suffer; real estate values decline; and the whole plan of city growth is upset.

Downtown street systems are incapable of accommodating present-day demands of traffic, except with major changes and compromise. Built without regard for automotive transportation, city streets fall far short of providing adequate capacity. Inheriting these conditions, public officials and traffic authorities are faced with the problem of relieving downtown congestion through the quickest and least costly means available.

The ideal solution would be to rebuild and supplement the entire street system. This approach is obviously impractical. The large financial outlays required for such a program will be available only over long periods of time, and such drastic reconstruction as would be necessary would destroy the businesses and enterprises that comprise the town.

While some significant improvements are being achieved through the construction of urban expressways and other projects, the demands on many miles of existing streets continue to grow. In looking for a practical means of improving the problem, traffic engineers have frequently turned to one-way streets.

While the use of one-way principles is not new, full-scale application has developed in only a few cities. Limited applications to special conditions such as a natural one-way movement around court-house squares have existed for many years. New York City adopted a basic system of one-way streets about 1907. Many other cities, particularly the larger ones, now have some one-way streets.

EFFECT OF ONE-WAY MOVEMENTS ON TRAFFIC FLOW

When the one-way regulation is applied to a street system, many basic changes are brought about in traffic behavior. It is because of these changes and not from sheer luck or circumstances that benefits are derived. For example, it is easy to see that with one-way operations, conflicts are greatly reduced at intersections. (See Figure 1.)

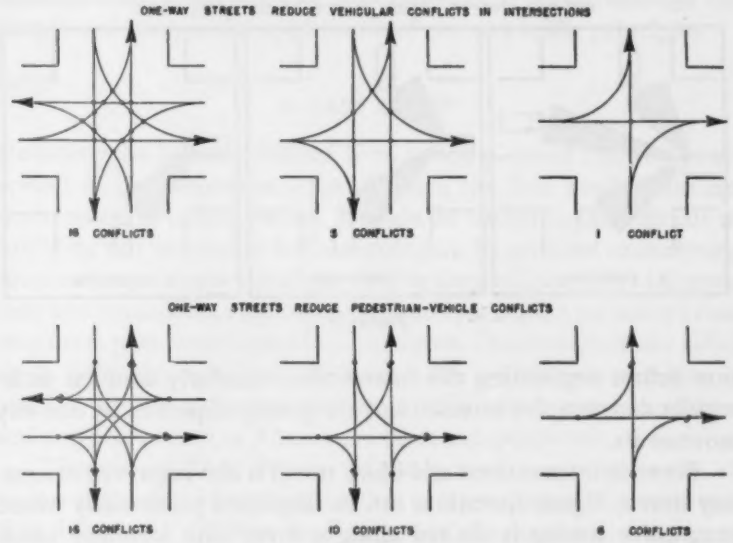

FIGURE 1

Under the simple conditions where two two-way streets intersect, each carrying only one lane of traffic in each direction, there are sixteen points of conflict of vehicular paths.[1]

One-way traffic on one of the streets reduces the points of conflict to five. With one-way movements on both streets, only one point of conflict remains. Conflicts between vehicles and pedestrians are likewise reduced through one-way movements—from sixteen to ten to six for the conditions just cited, as shown in Figure 1. These im-

[1] As the number of traffic lanes increases, the potential points of conflict increase rapidly. For example, when two four-lane streets intersect, each with two-direction traffic, 92 conflict points can develop between natural paths of vehicles.

provements make it evident that traffic operations at intersections will be expedited and the probability of collisions will be reduced through one-way operations.

There are other advantages. The driver approaching an intersection with two-way traffic must be on the alert for vehicles approaching from three other directions. Under one-way operations (Figure 2) the driver need only observe movements from one direc-

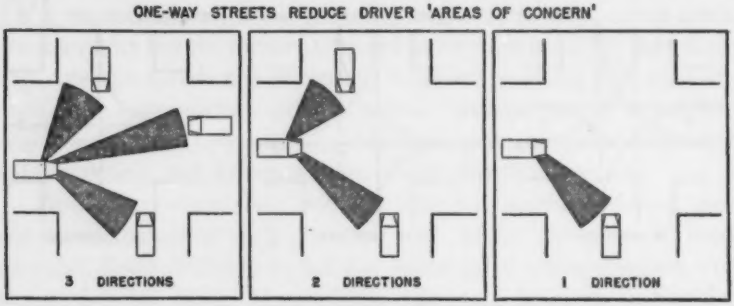

FIGURE 2

tion before negotiating the intersection. Similarly conflicts at irregular and complex intersections are greatly improved by one-way movements.

Between intersections mid-block travel is also improved on one-way streets. Signal operations can be simplified particularly where progressive timing is desired along a street with irregular block lengths. Head-on and side-swipe conflicts are eliminated. Pedestrians are not trapped between opposing traffic streams. Speed differentials are reduced. Conflicts between vehicles traveling in the same direction are eased because cutting-in is not forced by vehicles approaching from the opposite direction.

Common Results of One-Way Streets

Based on review of experiences with, and reports on, one-way streets in many cities, it is safe to predict many advantages from their use, to such changes as these. Briefly it can be said that one-way street systems usually (1) reduce accidents; (2) increase roadway capacity;

(3) increase travel speeds; (4) improve mass transportation services; and (5) benefit business. After a short transition period, they are usually fully accepted by motorists, public officials, and business groups. They move larger volumes of traffic with less congestion and hazard than the same streets with two directional traffic.

When downtown traffic is improved through one-way streets, more people are attracted to the area. Thus, the health of the central business district can often be maintained or restored, through the simple and inexpensive application of one-way traffic principles.

A CASE STUDY

Realizing the benefits derived from a well-planned one-way street system in the downtown areas of cities, the Eno Foundation has undertaken to collect data that might be useful to city officials in applying this important traffic regulation. In addition to analyzing facts and experiences already available, detailed case study information was needed. An excellent opportunity was afforded when a one-way street plan was adopted in New Haven, Connecticut in the fall of 1948. With the permission of local traffic authorities, members of the Foundation staff made studies of traffic volumes, speeds, delays, and trip performances. These were made independently.

The city of New Haven (165,000) covers approximately 18 square miles and serves a population of more than one-quarter million. Like many old New England towns, the main business part of the city has grown up near the water, with a very irregular street pattern. It is fortunate, however, that the heart of the retail district was originally planned in 1638, in the form of nine equal squares. While the planned gridiron system is limited in size, it facilitates the application of one-way principles in the most congested area.

As a means of relieving congestion and in order to make possible the application of other basic traffic regulations, a one-way plan was developed by the traffic engineer of the city. The plan was approved by city officials and put into effect on approximately ten miles of downtown streets September 26, 1948. This plan is shown graphically in Figure 3.

Before discussing the "before" and "after" results of the one-way system, it is significant to note that after a period of seven months, major alterations were made in the original plan and about 2 miles of major streets were returned to two-way traffic. This afforded an unusual opportunity to study traffic conditions under these different circulation plans, within a relatively short period of time.

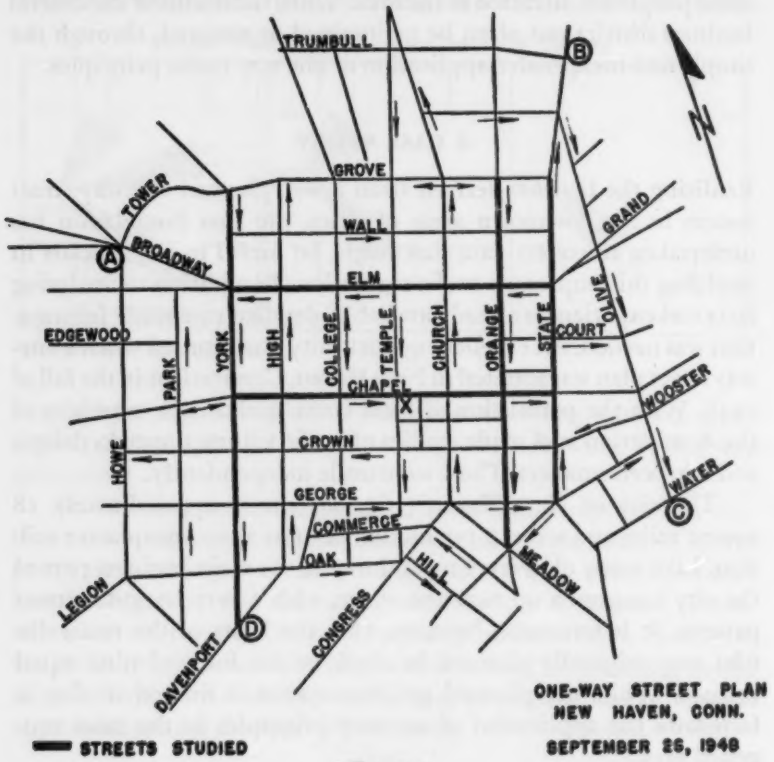

FIGURE 3

Plan of Study

Traffic surveys were made to determine vehicular volumes (passenger and commercial), speeds at key points, the travel time between given points, and the frequency and cause of delays. All studies were made on typical week-days—Tuesday, Wednesday, and

Friday. Monday and Thursday were excluded because of irregular store hours on those days. Both peak and off-peak conditions were determined.

To measure traffic performance before any changes were made, initial surveys were conducted during the week of September 1, 1948. The one-way street plan became effective September 26, 1948. Permitting time for motorists to become accustomed to the one-way system and change their driving habits accordingly, "after" studies were made during the week of November 1, 1948.

When the surveys were planned, it was not anticipated that the one-way plan of September 1948 would be modified—as was later done in May 1949. This accounts for the absence of additional, desirable data which might have been obtained.

On May 8, 1949 several of the more important streets which had been included in the one-way plan were returned to two-way operation. Chapel, Elm and State streets were among those returned to two-way operation. This action was not determined on a basis of traffic measurements or technical advice. At the time of writing this article, discussion was in progress toward the desirability of returning streets to one-way operation.

Table I

TRAFFIC VOLUMES

(12 HOURS 7 AM–7 PM)

	September 1948	*November 1948*		*May 1949*	
Location	*Volume*	*Volume*	*Change over Sept. 1948*	*Volume*	*Change over Sept. 1948*
Chapel (between York and High)	6820**	8500*	+25%	6735**	− 1%
Orange Street (between Chapel & Court)	6337**	6039*	− 5%	4559*	−28%
York Street (between Chapel and Elm)	5512**	8276*	+50%	3265*	−41%

* one-way traffic
** two-way traffic

For each condition, studies were made at the same location, during the same hours and on the same day of the week. No studies were made except during good weather.

RESULTS OBTAINED

Hourly vehicular volumes were recorded from 7 A.M. to 7 P.M. on two north-south streets—Orange and York—and on one east-west street—Chapel. There was a marked increase in traffic volumes on each of the streets except Orange after the one-way regulations were put into effect. (See Table I). The increase varied from 25 per cent to 50 per cent; Orange Street showed a 5 per cent decrease. Each of the streets carried less traffic in May 1949 after two-way movements were reinstated on Chapel than they carried in September 1948, before any changes were made.

Data obtained from the State Highway Department show no significant changes in traffic volumes in the area, or generally within the state, during the period; of studies in New Haven the small changes reported were all increases. It is reasonable, therefore, to assume that the changes on the streets in New Haven were mainly due to the one-way plan. It is significant that the street volumes were greatly reduced below their volumes prior to the initiation of the original plan, though two-way traffic was returned to only one of the streets studied (Chapel.)[1] This might indicate that an *incomplete* one-way system can result in negative volumetric effects on all major downtown streets. This occurs because all desired flows are not provided for equally.

Peak hour volume figures coincide closely with those for 12-hour periods. For example, on Chapel Street there was an approximate 20 per cent increase between 4 P.M. and 6 P.M. with one-way traffic, and when this street was changed back to two-way traffic it lost this 20 per cent gain. During the afternoon peak hours the street actually carried about 1 per cent fewer cars than it did in the fall of 1948, before the one-way regulation.

Hourly fluctuations in volumes on Chapel Street are shown in Figure 4. It will be noted that the traffic flow under the one-way plan was consistently above that of either of the two-way operations. The general pattern did not deviate appreciably except that a very heavy morning peak was found with one-way traffic which did not exist with two-way traffic.

[1] From observation, it appears that traffic was shifted to the remaining parallel one-way streets; this further reflects the hesitancy of motorists to use the congested two-way streets.

Hourly volumes are shown for Orange Street in Figure 5. On this street, one-way traffic has been retained since it was first applied in the Fall of 1948. This was one of the most congested streets in the city, and as will be noted in later discussion, the speeds were increased and delays reduced with one-way traffic. However, improvement in rate of movement was attained on this particular street at

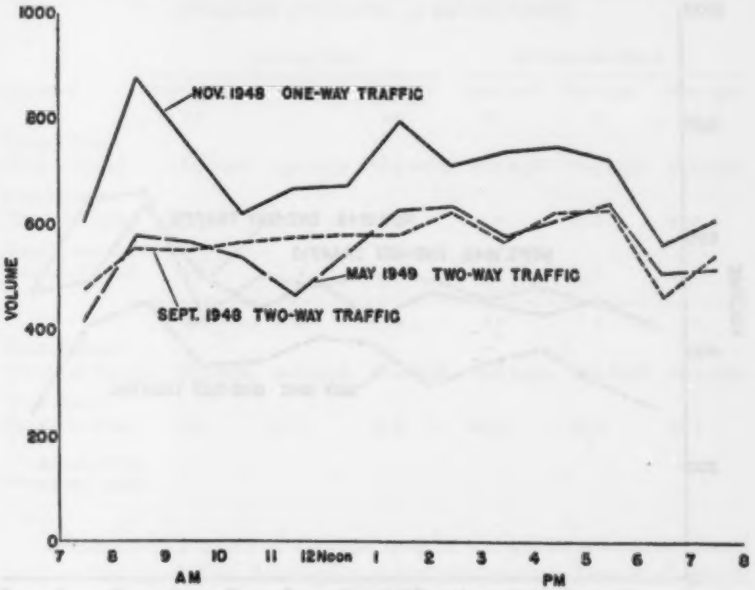

FIGURE 4

the expense of a slight decrease in traffic volumes. It will be noted that there was a decrease in some hourly volumes and an increase in others when one-way movements were applied.

This decrease in volume was probably due to the transfer of some vehicles to a more attractive parallel one-way street. All of the northbound traffic was shifted to other streets and the counterflows were divided between Orange, State, Temple and Olive streets, with Temple and Olive streets being wider and normally less congested. It was natural that they should attract motorists who would normally have been forced to use Orange Street southward. Also one direction

of transit traffic was routed off of Orange Street when it was changed to one-way.

With one-way traffic retained on this street there was a further decrease in volumes when two-way movements were restored on several other streets in May 1949. This additional decrease probably resulted from some southbound traffic shifting back to State Street.

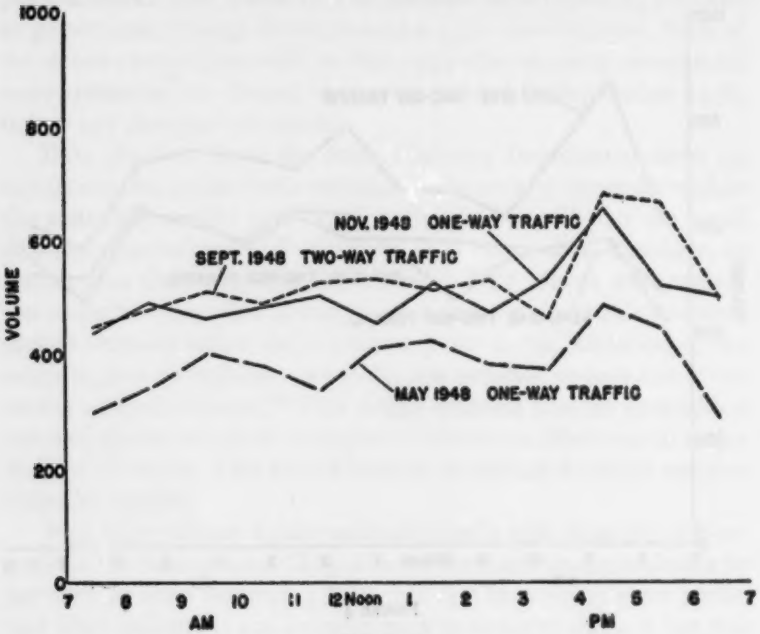

FIGURE 5

Speeds

Before-and-after speed measurements were taken at mid-block locations along five of the streets. Points selected for these studies were outside the most congested areas of the city. Because of the acute congestion during peak-hours, and the frequent accumulation of cars for appreciable distances at traffic signals, all spot speed surveys were taken during the morning off-peak periods (between 10 A.M. and 12 Noon).

During these hours, when traffic flow was comparatively free, there were increases in rates of movement in the one-way operations. Average speeds and 85 percentile speeds are shown in Table II.

Table II

OFF-PEAK SPOT SPEED DATA

(MID-BLOCK LOCATIONS, 10 AM–12 NOON)

	Average Speed			*85 Percentile Speed*		
Location	*Sept. 1948*	*Nov. 1948*	*May 1949*	*Sept. 1948*	*Nov. 1948*	*May 1949*
	**	*	**	**	*	**
Chapel Street (East of High)	18.7 mph	19.1 mph	18.9 mph	21.2 mph	21.5 mph	22.5 mph
Elm Street (East of High)	19.5	21.7	18.5	22.2	25.0	21.0
State Street (North of Wall)	19.6	21.3	19.7	22.1	24.6	23.0
	**	*	*	**	*	**
Orange Street (North of Court)	16.9 mph	20.6 mph	20.2 mph	19.8 mph	24.2 mph	24.2 mph
York Street (South of Elm)	21.5	21.6	21.6	24.5	25.0	24.4

* one-way traffic
** two-way traffic

Measured in terms of average speeds, the greatest improvement was on Orange Street. Average speeds there increased from 16.9 mph to 20.6 mph when the one-way regulation was applied. There was a slight increase in the average mid-block speeds on Chapel Street even though this street carried 25 per cent more vehicles when operating one-way.

On York Street there was practically no change in average speeds, but a 50 per cent increase in volume of traffic developed under the one-way plan. In every case where two-way traffic was reinstated, the average speeds dropped to about the values determined before any changes were made.

The speeds at or under which 85 per cent of the motorists were found to travel are also shown in Table II. It will be noted that these values reflect about the same changes as the average speed data. On

Orange Street, for example, 85 per cent of the motorists traveled at or under 19.8 mph before the street was made one way. Afterwards, the 85 percentile was found to be 24.2 mph—an increase of over 4 mph.

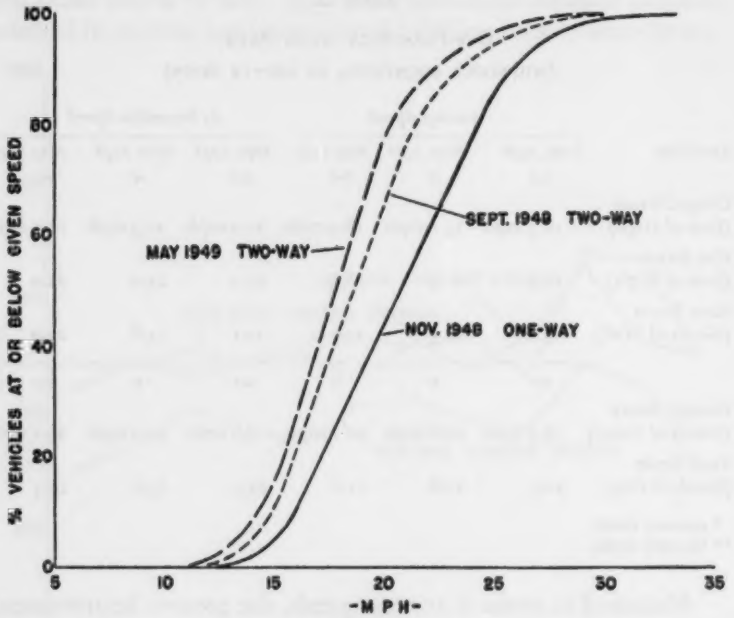

FIGURE 6

On Elm Street there was an increase from 22.2 mph to 25.0 mph with one-way traffic. When two-way traffic was resumed, the 85 percentile value dropped to 21.0 mph.

It is significant that all spot data show a greater facility of movement with one-way traffic.

To show the effect of one-way operations on the general distribution of mid-block speeds, cumulative distribution curves were plotted for Elm Street—Figure 6. It will be noted that the curve drawn from the data taken with one-way operations lies entirely to the right of the other two curves. This reflects an improvement in all speed groupings. The two curves representing speeds under two-way traf-

fic are very close together, however, the one to the left is for the conditions existing after the return to two-way traffic. It shows that the speeds were generally lower throughout all ranges than before the one-way trial. In another way, it can be said that there was a greater differential between the speed distributions with one-way traffic and those in May 1949, than there was between the speed distribution of one-way traffic and two-way traffic in September 1948.

Average Route Speeds

A more significant measure of facility of movement is obtained from a study of speeds over a given route. To ascertain the effect of one-way regulations on overall traffic movements, speed and delay studies were made during peak hours. In making these studies, the floating-car method was employed: trained observers operated a passenger car over the routes, conforming to existing conditions of traffic movement. Records were made of elapsed time, distances, and the causes and durations of delays. From these data it was possible to calculate the average speed for any given section of roadway and to show how time was spent in traffic under the various conditions prevailing.

Average running speeds are shown in Table III for each of the three periods of the study. On Chapel Street, between York and State streets (0.56 miles), the "before" average speed in September 1948 was 8.2 mph. When the street was made one-way in November 1948, the average speed increased to 11.2 mph, though traffic volume increased 25 per cent; and, when two-way traffic was resumed in May 1949 the average dropped back to 8.6 mph, about its former value. Expressed as a ratio, there was a 36.6 per cent increase in average speeds on Chapel Street with one-way traffic.

On Elm Street, the results of the one-way regulations were more pronounced, when measured in terms of average speeds between York and State streets. There was a 52.7 per cent increase, 9.1 mph to 13.9 mph, in average speeds with one-way traffic. When some of the streets, including Elm, were changed back to two-way traffic, the average route speed on Elm dropped to 6.0 mph— a 34 per cent decrease over the speed measured before one-way operations.

Table III

Average Speeds and Trip Times from Speed and Delay Studies

Street	Sept. 1948	Nov. 1948		May 1949		Sept. 1948	Nov. 1948		May 1949	
	Average Speed	Average Speed	Change over Sept. 1948	Average Speed	Change over Sept. 1948	Trip Time	Trip Time	Change over Sept. 1948	Trip Time	Change over Sept. 1948
	••	•		••		••	•		••	
Chapel Street (0.56 miles—York to State Sts.)	8.2 mph	11.2 mph	+36.6%	8.6 mph	+ 4.9%	4 min 5 sec	3 min 0 sec	—26.5%	3 min 55 sec	— 4.1%
Elm Street (0.53 miles—State to York Sts.)	9.1	13.9	+52.7%	6.0	—34.1%	3 min 29 sec	2 min 17 sec	—34.4%	5 min 18 sec	+52.2%
State Street (0.53 miles—George to Grove Sts.)	7.9	11.1	+40.5%	6.2	—21.5%	4 min 3 sec	2 min 53 sec	—28.8%	5 min 6 sec	+25.9%
	••	•		•		••	•		•	
Orange Street (0.65 miles—Grove to Meadow Sts.)	10.9 mph	13.1 mph	+20.2%	13.1 mph	+20.2%	3 min 35 sec	2 min 58 sec	—17.2%	2 min 59 sec	—16.7%
York Street (0.70 miles—Grove to Davenport Ave.)	13.9	13.3	— 4.3%	13.8	— 0.7%	3 min 2 sec	3 min 9 sec	+ 3.8%	3 min 3 sec	+ 0.6%

• one-way traffic
•• two-way traffic

Average speeds on State Street between George and Grove streets, followed almost exactly the Elm Street pattern. Marked increases resulted from one-way traffic with a return to slower movements when two-way traffic was reinstated.

On Orange Street there was a 20.2 per cent increase in average speeds between Grove and Meadow streets with one-way traffic. This

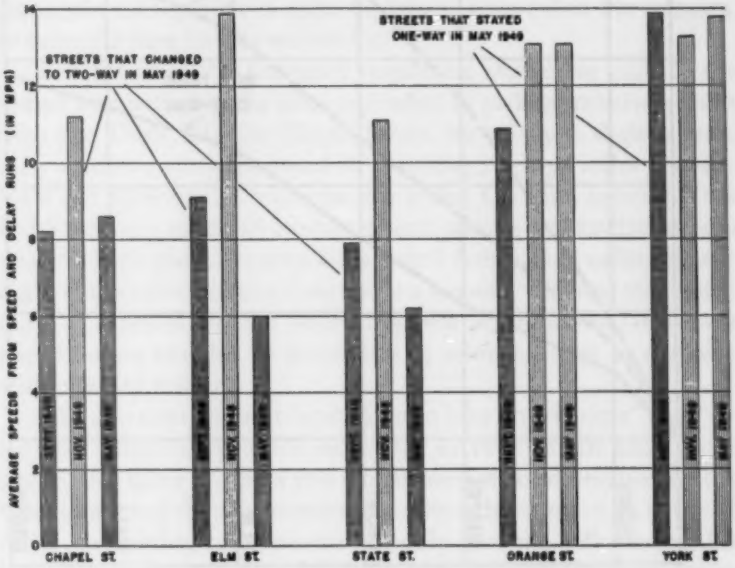

FIGURE 7

increase was continued after the changes in May 1949—probably because Orange was one of the streets on which one-way operations were retained.

York Street was the only street studied on which the average route speeds did not increase under the one-way plan. However, that street carried 50 per cent more traffic under the initial one-way plan. With this marked increase, almost no change was observed in average speeds from Grove Street to Davenport Avenue.

Average speeds on these five streets are shown graphically in Figure 7 for each of the observation periods. The benefits derived through increased speeds on one-way streets are evident.

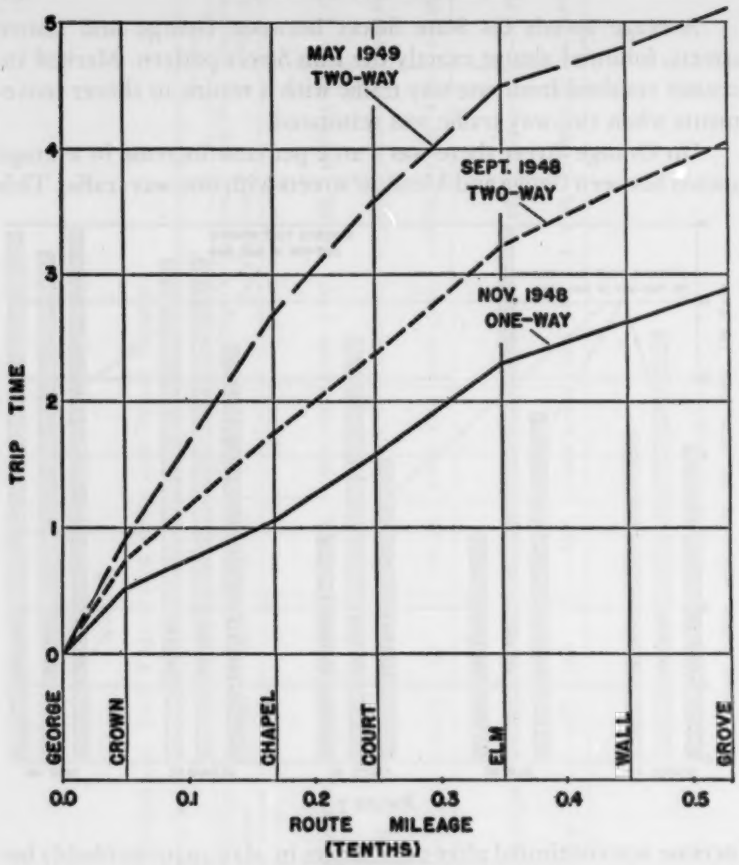

FIGURE 8

The speed study results represent averages over a given street. In order to show the variations in travel rates throughout different sections of a given route, charts were prepared by plotting distances against time. Inasmuch as most of the routes were in the downtown business district, few speed differentials were found. The average rate of travel in each block was almost constant.

To illustrate, curves for State Street are shown in Figure 8. It will be noted that the most congested section of State Street is between Crown and Elm. While there is a pronounced increase in the slope of curves (1) and (3) between these points, the curve representing

one-way operations (2) is almost a straight line with practically no change in the rate of travel throughout the entire length of State Street between George and Grove streets.

The total trip took slightly less than 3 minutes with one-way traffic as compared with a little more than four minutes before any change was made. When State Street was returned to two-way movements, the average time to make the trip was more than five minutes, or twice the time for one-way traffic.

Benefits from the increased speeds are shown for each of the streets by comparing the time expended in making relatively short trips (see Table III). On Chapel Street, for example, slightly more than a minute could be saved in traveling the 0.56 miles between York and State streets, with one-way traffic. On Elm, between York and State, 0.53 miles, an average of one minute and twelve seconds was saved; on State, between George and Grove, 0.53 miles, the saving averaged about one minute and ten seconds, with one-way traffic. On 0.65 miles of Orange Street, between Meadow and Grove, the trip time was reduced by more than ½ minute, about 17 per cent, with one-way traffic.

The trip time has been broken down into "travel time" and "delay time" (time stopped) for each of the surveys, on Elm and Chapel streets, in Figure 9. These two streets were selected because the distances between the trip termini are about the same—0.53 and 0.56 miles—permitting comparisons not only between different studies but between the two streets. In both cases the total trip time was reduced through one-way traffic. The major savings come from reductions in time spent in delays, since the actual time in motion was about the same before and after one-way operations. When the two-way traffic was resumed on each of the two streets, the delay time, or time not in motion, returned to, or exceeded its initial values. An increase in travel time coupled with more delays caused the total trip time on Elm Street to materially exceed that for either of the initial, or one-way conditions.

Delay stops were classified as to whether they were caused by traffic interference or traffic controls. Maneuvers from parking, turning, pedestrians, and other traffic conditions were considered as traffic interference. Traffic control delay stops consisted of losses due to signals or traffic officers. Comparisons are given in Table IV.

Marked reductions were found in the delay time with one-way operations. On Chapel Street, an average of 120 seconds was lost in delays over the 0.56 mile section with the old two-way traffic plan. The delay on the same run was only 37 seconds with one-way traffic. This represents a savings of 83 seconds, 69 per cent, for the average trip. When two-way traffic was returned to Chapel Street, the delay

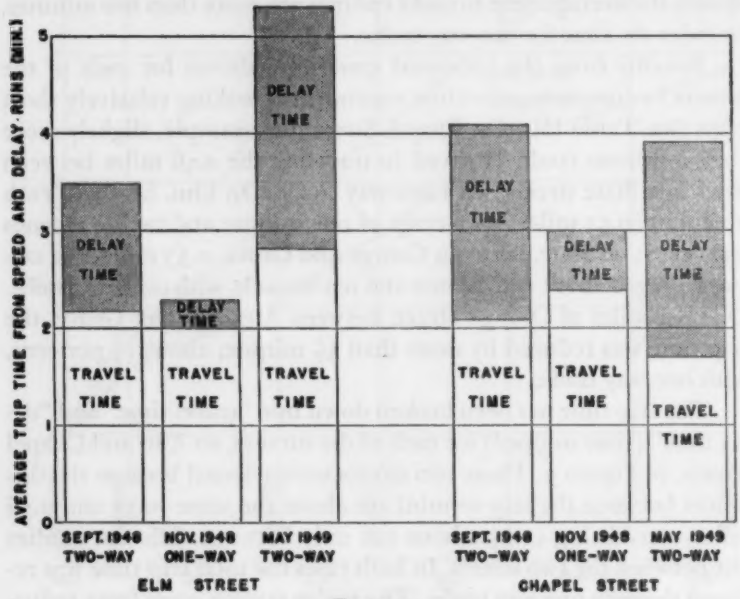

FIGURE 9

increased to an average of 133 seconds per trip. This is 13 seconds longer than the average time required under the two-way system in effect prior to the one-way plan.

Similar time savings are noted for all of the streets. With the return to the two-way plan on State Street the total delay time was about double the previous two-way delay time. The delay of 136 seconds under the last plan, for a trip of 0.53 miles, is more than three times the average delay of 40 seconds for a trip under one-way traffic conditions.

Again, however, it might be pointed out that on Orange and

Table IV

Delays and Time Savings from Speed and Delay Studies

Street and Type Delay	Sept. 1948 Stopped Delay **	Nov. 1948 Stopped Delay *	Nov. 1948 Change over Sept. 1948 Seconds ±	Nov. 1948 Change over Sept. 1948 % ±	May 1949 Stopped Delay **	May 1949 Change over Sept. 1948 Seconds ±	May 1949 Change over Sept. 1948 % ±
Chapel St. (0.56 miles—York to State St.)							
—Traffic Control	110 secs	35 secs	−75 secs		127 secs	+17 secs	
—Traffic Interference	10	2	− 8		6	− 4	
—Total	120	37	−83	−69.2%	133	+13	+10.8%
Elm St. (0.55 miles—State to York St.)							
—Traffic Control	76	17	−59		137	+61	
—Traffic Interference	3	0	− 3		12	+ 9	
—Total	79	17	−62	−78.5%	149	+70	+88.7%
State St. (0.53 miles—George to Grove St.)							
—Traffic Control	69	40	−29		129	+60	
—Traffic Interference	10	0	−10		7	− 3	
—Total	79	40	−39	−49.4%	136	+57	+72.2%
	**	*			*		
Orange St. (0.65 miles—Grove to Meadow St.)							
—Traffic Control	48 secs	32 secs	−16 secs		25 secs	−23 secs	
—Traffic Interference	21	4	−17		4	−17	
—Total	69	36	−33	−47.8%	29	−40	−58.0%
York St. (0.70 miles—Grove to Davenport Ave.)							
—Traffic Control	37	35	− 2		34	− 3	
—Traffic Interference	5	2	− 3		1	− 4	
—Total	42	37	− 5	−11.9%	35	− 7	−16.7%

* one-way traffic
** two-way traffic

York streets, the average time savings per trip continued after the return of two-way traffic to some of the street. Orange and York streets were not returned to the two-way system.

On most of the streets it was found that the major delays were caused by traffic control measures. This is in part due to the fact that the term "delay" was taken to mean only time during which the car was stopped. Many of the traffic interferences caused slowdowns, but did not necessitate stops. Again referring to Table IV, it will be noted that the average 120 seconds delay on Chapel Street with the initial two-way traffic in September 1948 was made up of 110 seconds due to traffic controls and 10 seconds due to traffic interferences.

Through improvements in signal timing and the elimination of the necessity for traffic officers on point control duty, permitted by one-way operations, major savings were made in traffic control delays. On Chapel Street, the 110-second delay period was reduced to 35 seconds at traffic control devices. Excepting York Street, which was lightly traveled prior to the one-way plan, delay time due to traffic control were reduced from 33 per cent to 77 per cent with one-way streets.

Percentage reductions in delay time caused by traffic interferences were greater than reductions in delay time due to traffic controls. The actual time saved, however, through improvements in traffic interferences was not as appreciable because, as already pointed out, the time actually spent in stops due to these interferences was relatively small.

Other interesting comparisons between traffic movement and traffic control delays were apparent. Before one-way traffic was applied, from 70 per cent to 97 per cent of the total delay on all streets in the survey, was at intersections. Under the one-way plan, delays due to traffic controls comprised a higher percentage of the total delay time. On two of the streets all delays recorded were for traffic control purposes, and never more than 12 per cent of the delay time was attributed to traffic interferences with one-way movement.

Typical Trips

To measure the effect of one-way traffic on trips from various sections of the city, four points of trip origins were selected near the periph-

ery of the one-way network. All were important points of entry for the downtown area. Trips were made by the most direct route available from these points to the entrance of large department stores on Temple Street between Chapel and Center, about the center of the retail business district. In every case the vehicle was driven to a position permitting the discharge of passengers at the curb directly in front of the entrance to the store. The points selected as trip origins, one in each of four quadrants, and the single destination are shown in Figure 3.

Inasmuch as the routes of travel had to be changed to fit the pattern of one-way streets, it was desired to ascertain, for each of the traffic plans, (1) the distance traveled; (2) the total time required; and (3) the average speed from each of the four outlying points to the downtown destination. Average values obtained from many trips between the selected points are shown in Figure 10.

Before the one-way plan was instituted, the trip from Point A (Tower and Broadway) to point x destination was .86 miles and the average time required to make th trip was 5 minutes 46 seconds—an average speed of 8.9 mph. With the one-way streets, the travel distance was reduced to .64 miles and the trip time to 3 minutes 37 seconds. Average speed increased to 10.6 mph. The significant factor, however, is that trip time was decreased 2 minutes 9 seconds, or 37 per cent, as a result of the increase in speed and the decrease in distance.

The trip from point B (State and Trumbull) was reduced from .93 miles to .87 miles under the one-way plan. The time required to make the trip was cut in half—from 9 minutes 8 seconds to 4 minutes 37 seconds. This large saving was due in part to the reduced mileage, but mainly to higher average speed. The average speed increased from 6.1 to 11.3 mph.

The trip from point C (Water and Olive) required a greater travel distance under the one-way plan, due to the necessity of properly approaching the curb at the destination. See Figure 3. The distance with one-way traffic increases to .9 miles from .62 miles, 45 per cent. The trip time was increased only 26 per cent, from 4 minutes, 58 seconds to 6 minutes 16 seconds. The rate of travel was increased by the freer one-way flows, from 7.5 mph to 8.6 mph.

From the remaining point D at Davenport and York streets, the

trip distance was increased under the one-way plan. With a slight increase of 0.04 miles in distance, however, the travel time increased only 12 seconds and the average speed was 0.1 mph higher with one-way traffic. In this case the one-way plan had almost no effect on the trip characteristics. The slight changes in traffic performance, however, were all favorable.

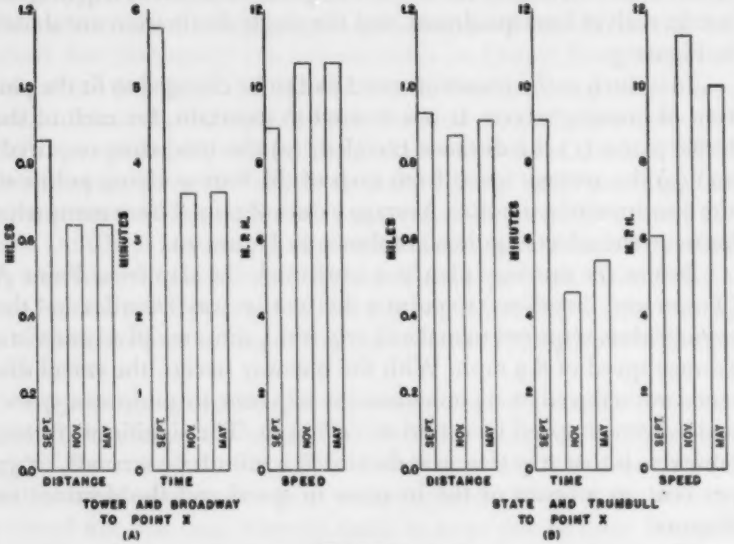

FIGURE 10
A–B

Summarizing all trips, improvements are shown in two; the third showed only a slight improvement; and the fourth resulted in increased distance and trip time, but at higher speed.

When some of the streets were changed back to two-way traffic, trip studies were again made between the same points. The results of these studies are also shown in Figure 10. By comparing the bar graphs for the third study with those for the two previous studies, the trip time and average speeds were improved where one-way streets were an appreciable part of the total trip.

From this simple case study it appears that one-way streets afford a simple means of increasing the capacity of urban thoroughfares;

that if properly integrated in a plan they can do much to make congested districts accessible.

Though more vehicles are attracted to one-way streets, the travel time on such streets is less than when the same streets carried two-way traffic. Proper timing of traffic signals for progressive movements is greatly simplified under one-way operations. While higher

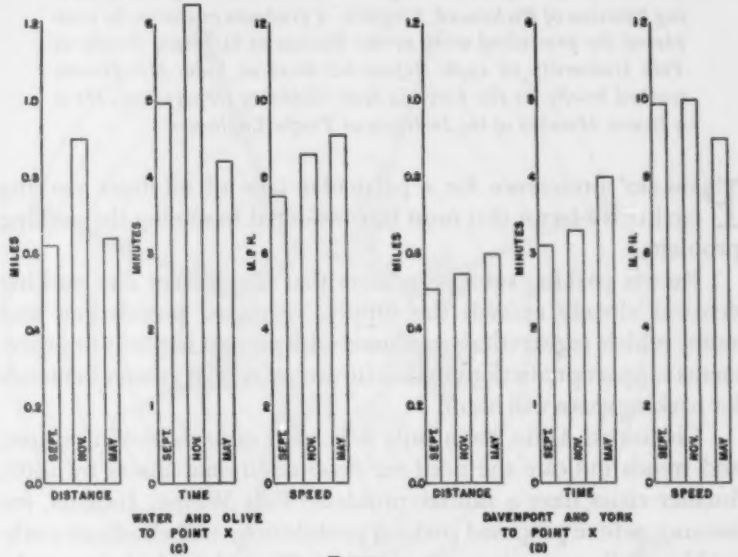

FIGURE 10
C–D

average speeds are obtained with one-way traffic, top speeds are not greatly increased. In downtown districts, speeds of all vehicles are uniformly increased, but previous top speeds are not appreciably increased because of the one-way regulation.

When it is necessary to travel a greater distance to a specific destination on one-way streets, the added distance is usually offset by increased speeds. An overall one-way plan is essential to the successful application of the one-way rule. A partial plan may not only upset traffic operations on one-way streets; it may also cause additional problems on major two-way streets in the area.

Factors Affecting Parkers' Choice of Parking Lots or Garages

JOHN T. HANNA

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PARKERS' preference for a particular type of off-street parking facility is a factor that must be considered in solving the parking problem.

Recent parking surveys indicate that the present city parking demand already exceeds the supply. Increased populations and motor vehicle registrations combined with present highway improvements support predictions that in future years even greater demands for parking space will occur.

Cincinnati, Ohio, has a daily deficiency of 2250 parking spaces, and trends indicate the need for 6000 *additional* spaces by 1968. Smaller cities have a similar problem: Fort Wayne, Indiana, for instance, where proposed parking prohibitions will eliminate curb-parking stalls now serving 6405 cars daily. Although these restrictions will increase the flow capacity of these streets, they will also create a heavy demand for parking that can only be served by adequate off-street facilities.

Many of the more progressive cities are forming parking authorities, or similar groups, to help solve the parking problem. Lansing, Michigan has a plan to acquire thirty-two different locations to be used for new parking facilities. Most of the officials in these cities are ignoring the basic likes and dislikes of the parkers who will use these spaces.

Lots vs. Garages

Availability of land, land cost, and parking demand largely determine the type of off-street parking facility to be used at a particular

location. Once the facility has been put into service, only efficient operation and reasonable parking rates will insure its continued financial success.

DISTANCE TRAVELLED TO THE FACILITY BY PARKERS

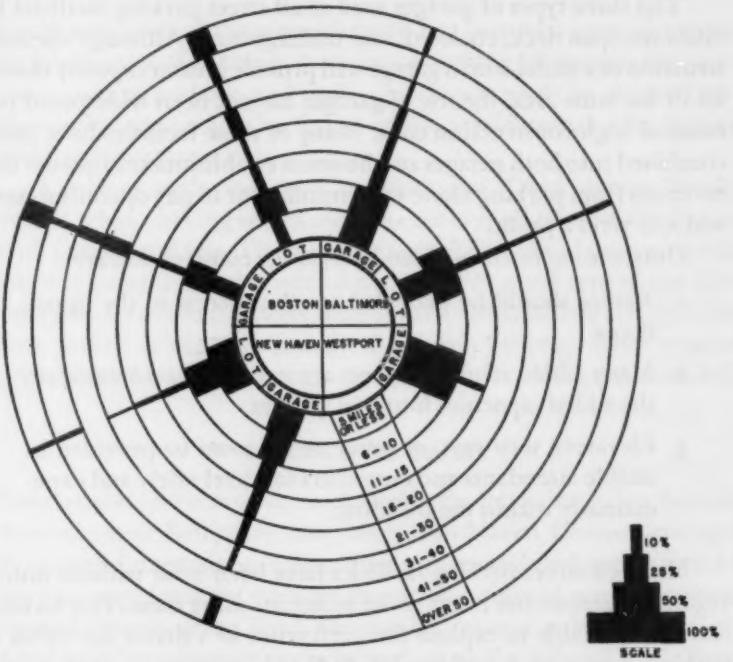

FIGURE 1

According to the results of an American Automobile Association study in seventy-two cities, 58 per cent of the total off-street parking space in these cities was in parking lots, and these lots received 78 per cent of the off-street parking business. However, many lots are used as temporary off-street parking facilities only, and owners plan to sell the land when an attractive offer is received.

Some of the more recent standards in lot design are:

1. Fences and barricades around lots to discourage theft

2. Surfacing, grading, and dust-preventive measures used to provide cleaner service and a better community appearance.
3. Curb cutbacks and driveways controlled to reduce hazards to pedestrian and vehicular movement.

The three types of garages used as off-street parking facilities in cities are open deck, enclosed, and underground. Although the construction of a multi-stored garage will provide greater capacity than a lot of the same area, the use of garages has not been widespread because of high construction costs. Many of these facilities have been combined into both garages and business establishments because the revenues from parking alone were insufficient to pay operating costs and still yield a profit.

Outstanding features of modern garage construction are:

1. Ramps should be provided to allow access to the upper floors.
2. Many added reservoir spaces are needed to accommodate the added capacities found in garages.
3. Elevators, stairways, or other means must be provided to enable attendants and customers to travel safely and expeditiously within the building.

Many off-street parking facilities have been built without much regard for desires and needs of the motorists using them. Few factual data are available to explain the preference of a driver for either a parking garage or a parking lot. Still this preference, if it exists, might well mean the difference between the financial success or failure in the operation of an off-street parking facility.

The purpose of this study was to obtain a better understanding of the effects of weather conditions, parking fees, services offered by facilities, and various psychological factors on the selection of the parker. In essence this means simply, What induces a parker to select a garage or a lot, and how can the facility operators obtain more revenue and greater utilization from existing and potential parking spaces?

Whether or not the operators of off-street facilities will be amenable to suggested changes that would improve their business and add to greater customer-satisfaction, only the future can tell; but here, at least, will be factual data upon which they can base their decisions.

Previous Studies

Until now, most of the research work has been of a general nature pertaining to driver habits, duration of parking for various trip purposes, costs of parking, and walking distances made by the parkers. No specific data could be found which would reveal why drivers preferred garages or lots.

A related study was made in Cincinnati, Ohio, during World War II when parking spaces were available at all times of the day in both garages and lots. There were an equal number of spaces in both lots and garages. Final results showed that 25.4 per cent of the daytime parkers selected garages, 21.6 per cent selected lots, and 53.0 per cent parked at the curb (mostly short-time parkers). Basic reasons given by parkers for selecting a particular facility were not included.

METHOD OF STUDY

Four separate surveys were conducted in the following cities: Boston, Massachusetts; Baltimore, Maryland; New Haven, Connecticut; and Westport, Connecticut. All parking garages and parking lots where parkers were interviewed were on opposite sides of one-way streets, located directly across from one another, except at Westport, Connecticut, where the garage was located across the railroad tracks from a free parking lot. No study was made at the free lot because most parkers were induced to park there due to the free service provided.

Both facilities in the Boston study were located in the heart of the down town theatrical district. Since these facilities were also near the shopping district, this survey disclosed the reasons given by both the shoppers and the recreational parkers for preferring either a garage or a lot.

In Baltimore the survey was located in the shopping section of the central business district. At this location the garage was adjacent

to and operated by a large department store. The facility attracted mostly the short-time shopping parkers. The lot directly across the street had a ticket validation service arrangement with several other large department stores in the area along with its regular parking fee system. Thus both facilities primarily attracted the short-time shopping patrons.

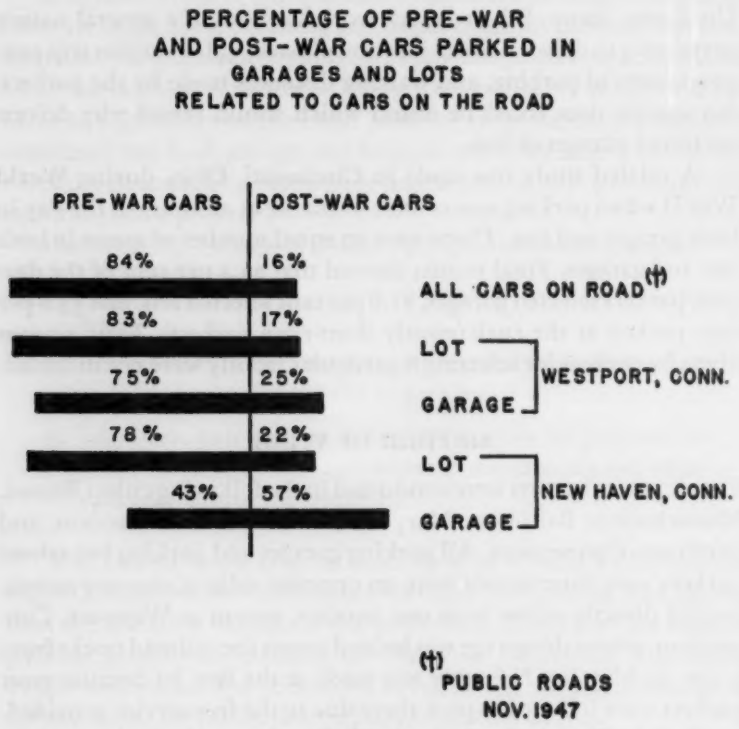

FIGURE 2

The garage and lot in New Haven were located in a semi-shopping and semi-working district and attracted both workers and shoppers during the day. A night survey was included at this location to disclose why night parkers selected a particular facility and to check these reasons with those given by day parkers at the same locations.

A final survey was run in Westport for the following reasons:

1. To determine whether or not the reasons given by the prosperous type of parker varied from those of other parkers.
2. To determine reasons why commuter parkers selected the garage when a free lot was available 100 feet away.

To prevent adverse weather conditions from affecting the choice of parkers, surveys were conducted during periods of clear weather only. When inclement weather occurred, results were discarded, and the study was made on a later date. Average temperatures during the various surveys ranged from 32° to 45° F.

An interviewer was stationed at the garage and at the lot to question each parker after he had left his parked vehicle. Parkers were not questioned in the presence of an attendant since this condition might have influenced the answer. Questions asked and exact answers given were recorded. Leading questions were avoided where possible. Hesitant persons were not prompted.

Studies were conducted as follows:

Location of Survey	*Hours*	*Day*	*Date*
Boston, Massachusetts	8:00 AM to 6:00 PM	Saturday	October 29, 1947
Baltimore, Maryland	8:00 AM to 6:00 PM	Friday	January 30, 1948
New Haven, Connecticut	8:00 AM to 9:00 PM	Thursday	March 18, 1948
Westport, Connecticut	8:00 AM to 6:00 PM	Thursday	March 25, 1948

No interviews were taken after either facility had reached operating capacity or when any physical condition prevented a free choice of both facilities. Even when the traffic volumes became excessive enough to prevent free movement into either facility, the parkers were not interviewed.

Commanding officers of Police Traffic Bureau in Baltimore, Maryland; Richmond, Virginia; New Haven, Connecticut; and Hartford, Connecticut, were interviewed personally relative to the complaints that they had received during the past three years against lots and garages from parking customers or residents of the city. This study was included to give some measure of the attitude of both police and citizens regarding the operation of the two facilities.

As a supplement to the previous study, form letters were sent to 64 municipal, state, and government traffic engineers. The letters requested both opinions and factual data from these men.

Studies were made of both the age and the make of every car parked in the garage and lot in New Haven, Connecticut, and in Westport, Connecticut, during the periods of the surveys.

ANALYSIS OF DATA

A total of 516 parkers were interviewed at the seven survey locations. This number constituted 29 per cent of the 1791 parkers at the facilities during the periods of the surveys. At the garages 23 per cent or 302 of the 1342 parkers were interviewed as compared to 48 per cent or 214 of the 449 lot parkers. There were only two interview refusals during the entire periods of the surveys.

In an opinion questionnaire survey, it is difficult to obtain valid answers. An attempt was made, however, to word all questions used in this survey so that persons interviewed would not misconstrue the intent. When possible, the questions could be answered with a simple "yes" or "no."

The parkers were not interviewed until they had alighted from the parked vehicle. This approach, it was believed, would yield more indicative answers to the question of why the particular type of facility was selected.

The original questionnaire was expanded for subsequent surveys when the first survey conducted revealed that there were other conditions that affected the choice of parkers.

The sex of parkers interviewed was recorded in the Baltimore, New Haven, and Westport surveys. This information was desired for the following purposes:

1. To determine the influence that various parking facilities had on men as compared to women.
2. To compare the reasons of men and women for selecting the same facility.

Analysis indicated that 39 per cent of the parkers interviewed in the Boston garage were shoppers, 27 per cent were participating in

recreational activities, 19 per cent were attending business, and 15 per cent were workers. These results differed slightly from results of the lot parkers whose purposes were 29 per cent shopping, 29 per cent on business, and 37 per cent were recreation. Seventy-four per cent of the parkers interviewed in the Baltimore garage were shoppers and 17 per cent were on business.

The rest of these parkers had work, recreation, or other as their trip purposes. Final analysis of the trip purposes given by the lot parkers showed that 65 per cent were shoppers, 27 per cent were on business and the remaining 8 per cent were downtown for work, for recreation, or for other purposes. A slightly higher percentage of the parkers with business as the trip purpose parked in the lot.

The New Haven garage survey disclosed the following trip purposes: 35 per cent business, 24 per cent work, 45 per cent recreation, 4 per cent shopping, and 4 per cent other purposes. In the lot 14 per cent of the parkers were shoppers, 35 per cent were on business, 24 per cent were workers, 26 per cent were there for recreation, and 4 per cent were in the central business district for other purposes.

Ninety-two per cent of the commuter parkers in the Westport garage were going to work, and 8 per cent were engaged in recreation.

Each parker was asked the distance in miles that he had traveled from his origin (home or place of overnight lodging) to the parking facility. Drivers who were uncertain of the exact mileage were asked to state the location of their origin and the distance was ascertained later from scaled maps of the area.

Thirty-nine to 96 per cent of the parkers using all facilities traveled from one to ten miles. Further results of this study disclose that as the population of the cities increased, the percentages of the parkers who traveled longer distances also increased.

A further study showed that a majority of the parkers using both facilities traveled from six to ten miles, in all cities except in New Haven where the majority traveled from one to five miles. Also the analysis indicated that as the size of the cities increased, the number of long-distance parkers using the lot or garage also increased.

No evidence was found to substantiate the frequent claim that the long-distance parkers prefer to park in garages. Overnight parkers who selected the garages at the survey locations did so be-

cause the lots did not offer 24-hour service. Where both garages and lots offered service during the same periods, there was an equal distribution of long-distance parkers in both facilities.

SUMMARY

Surveys were conducted in parking lots and parking garages in four different cities to determine why drivers choose particular facilities under similar conditions. All parking garages and parking lots where parkers were interviewed were on opposite sides of one-way streets, located directly across from one another, except at Westport, Connecticut, where a free lot was located across the railroad tracks from the garage.

A synopsis of the more positive findings listed in the preceding data is given as follows:

1. Parking lots and parking garages are each patronized by a definite type of parker. As a general rule, the garage parkers were very casual and in no general hurry. The parkers in lots represented opposite extremes in that most of them were in a great hurry to get to their destinations.

2. The accumulation characteristics for garages varied from those in lots in accordance with location, parking demand, and types of parkers, even though both facilities were located directly across from each other on one-way streets.

3. Most of the parkers interviewed in both lots and garages had traveled from one to ten miles to the parking facilities. Where garages and lots both offered service during the same periods, there was an equal distribution of the long and short-distance parkers in both facilities.

4. Eighty per cent of all garage parkers had definitely planned to park in the garages. Fifty-eight per cent of all lot parkers had definitely planned to park in the lots. Higher percentages of women than men had more definite plans on where they expected to park.

5. Ninety-three per cent of all garage parkers preferred to park in garages. Fifty-eight per cent of all lot parkers preferred to park in lots. Higher percentages of women preferred garages; whereas, higher percentages of men preferred the lots.

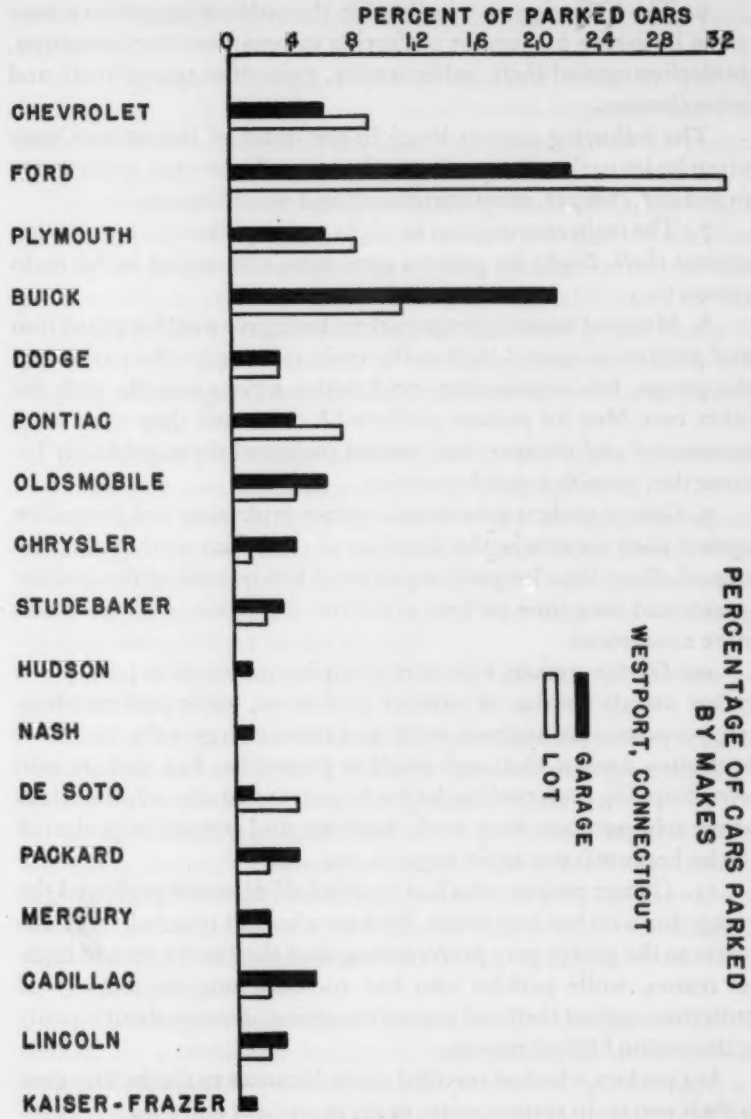
PERCENT OF PARKED CARS
0 4 8 1,2 1,6 2,0 2,4 2,8 3,2
CHEVROLET
FORD
PLYMOUTH
BUICK
DODGE
PONTIAC
OLDSMOBILE
CHRYSLER
STUDEBAKER
HUDSON
NASH
DE SOTO
PACKARD
MERCURY
CADILLAC
LINCOLN
KAISER-FRAZER
PERCENTAGE OF CARS PARKED BY MAKES
WESTPORT, CONNECTICUT
GARAGE
LOT

FIGURE 3

6. The following reasons listed in the order of importance were given by garage parkers for preferring garages: *weather protection, protection against theft, better service, protection against theft,* and *miscellaneous.*

The following reasons listed in the order of importance were given by lot parkers for preferring lots: *quicker service, easier to get in and out, cheaper, more convenient,* and *miscellaneous.*

7. The main reason given by night garage parkers was *protection against theft.* Night lot parkers gave *more convenient* as the main reason for preferring to park in the lots.

8. Men and women garage parkers both gave *weather protection* and *protection against theft* as the main two reasons for parking in the garage, but women also rated *better service* equally with the other two. Men lot parkers preferred lots because they were *more convenient* and *cheaper,* but women preferred them primarily because they provided *quicker service.*

9. Garage parkers gave more *weather protection* and *protection against theft* reasons as the duration of time they were parked increased. Short-time lot parkers preferred lots because of the *quicker service* and long-time parkers preferred the facility because it was *more convenient.*

10. Garage parkers who were shopping preferred to park in the garage mainly because of *weather protection,* while parkers whose trip purposes were business, work, and recreation gave the reasons of *protection against theft* and *weather protection.* Lot parkers who were shopping preferred the lot for its *quicker service,* while parkers whose trip purposes were work, business, and recreation preferred the lot because it was *easier to get in and out.*

11. Garage parkers who had traveled all distances preferred the garage for *weather protection.* Parkers who had traveled short distances to the garage gave *protection against theft* as the second highest reason, while parkers who had traveled long distances rated *protection against theft* and *protection against damage* about equally as the second highest reasons.

Lot parkers who had traveled short distances to the facility gave as their two main reasons *easier to get in and out* and *cheaper.* However, the lot parkers who had traveled longer distances rated *quicker*

service and *easier to get in and out* as the two main reasons for parking in the lot.

12. Higher percentages of *businessmen* and *executives* parked in the garage, and higher percentages of *service employees* and *professional workers* parked in the lots. The reasons given for preferring both garages and lots varied for parkers of different professions.

13. In garages where attendant parking was in effect, from 54 to 59 per cent of the parkers preferred to have attendants park their cars. In the garage where there was a choice of attendant or customer parking only 25 per cent desired to have the attendant park the car.

In lots where attendant parking was used, from 57 per cent to 60 per cent of the parkers desired to have attendants park their cars. Higher percentages of women than men desired to have attendants park their cars.

14. Higher percentages of both post-war and higher-priced cars were found in parking garages than in the parking lots.

15. More complaints were received by police departments against parking lots than parking garages by both customers of the facilities and citizens at large. The results of this preliminary study were very stimulating, and it is hoped that they will encourage further research work of this nature.

On the basis of the foregoing data the following conclusions are included herewith:

1. Despite the limitations of the questionnaire survey method used in this study, this method indicated many of the factors which determine the choice of parkers for garages or lots.

2. There was no sharp division of preference of parkers for garages or lots either by sex, professions, purpose of trip, distance traveled to the facility, attendant or customer parking, duration of the time parked, or rates at the facilities. However, the reasons given by parkers for preferring a particular facility were greatly influenced by the foregoing factors.

3. The major reasons found for the choice of parkers are characteristic for a particular facility: Garage parkers liked the garages primarily for *weather protection* and *protection against theft;* secondary reasons for preferring garages were *better service* and *protection against damages.* Lot parkers liked the lots because of the

quicker service and the fact that they were *easier to get in and out;* secondary reasons given for preferring lots were *cheaper service* and *more convenient.*

4. Reasons given by parkers for preferring lots and garages disclosed that minor improvements in some existing and all future off-street facilities would result in greatly increased parker satisfaction for the service rendered: Garages would be more appealing to parkers if greater ease of access and egress and quicker service were provided. Lots would be more appealing to parkers if a comfortable waiting room and better protection against theft were provided.

5. In both lots and garages where a choice of attendant or customer parking exists, a majority of parkers prefer to park their own cars. In similar facilities where attendant parking has always been in effect, and no other facilities in the city offer customer parking, parkers prefer to have attendants park their cars. Higher percentages of women prefer attendant parking than do men in both lots and garages.

6. High percentages of post-war cars were found parked in both garages and lots. Designers should give this fact strong consideration in order that new facilities will not become obsolete in a few years because of poor design.

Traffic Engineering as a Profession

ROBERT S. HOLMES

Mr. Holmes has been Executive Secretary of the Institute of Traffic Engineers since April 1, 1947. He is experienced in highway and traffic engineering and in related fields, including research, traffic education and public training work, police traffic control, and traffic engineering administration. After training at the Yale Bureau of Highway Traffic, he was assigned to the Special Highway Division, Pennsylvania Turnpike Commission and later joined the traffic engineering staff of the National Conservation Bureau. For sixty-two months in World War II, he was engaged in traffic engineering and control for the army, and later served as Assistant War Department Safety Director, responsible for organization and administration of an army motor vehicle safety program. He is a member of the Institute of Traffic Engineers, an associate member of the American Society of Civil Engineers and of the American Society of Safety Engineers. He is a member of the Department of Traffic and Operations of the Highway Research Board and Editor of "Traffic Engineering" magazine, official publication of ITE.

PUBLIC officials and civic organizations turn increasingly to traffic engineering skills as a means of helping with accident and congestion problems. This engineering component is being applied to the *operation* of roads, vehicles, and the road user as a *system* called "traffic."

The traffic engineer serves, therefore, as an important connecting link between the automotive engineer, who is responsible for the vehicle, and the highway engineer, who is responsible for the *structural* performance of streets and roads.

Traffic engineering has long been established as an essential in traffic control. While traffic engineering functions are readily understood by the official and private organizations actively engaged in traffic control, a recent public opinion poll found that only 8 per cent of the public gave any weight to the contribution of engineering as a factor in solving the traffic problem.

The traffic engineer is constantly being urged to develop *traffic engineering consciousness* in the minds of the average citizen. He is continuously being asked, why Traffic Engineering? What are the

duties of a Traffic Engineer? Is it a police function? Do you need a college education? What benefits derive from engineering services?

These and many other questions need answering before there is general public acceptance of traffic engineering as an essential ingredient in the relief of traffic problems. This discussion of the subject "Qualifications of a Traffic Engineer" is an attempt to answer some of these questions.

Development of Traffic Engineering Activities

Rapid development of automotive transportation followed the first world war. Accidents and congestion that followed in the early twenties were responsible for public demands that expert attention be directed to the alleviation of traffic ills. During this period, a few individuals recognized the value of engineering approaches in dealing with many aspects of highway transportation problems. Men with engineering training and experience worked with municipal officials in seeking palliatives for accidents and congestion, largely concentrating their work in the field of traffic regulatory devices, and roadway design and re-design.

A major reason for organizing the Institute of Traffic Engineers was to encourage the establishment of traffic engineering departments in city and state governments, whose techniques should make for safer and more efficient highway transportation. At a meeting in January, 1931, a Constitution and By-Laws were adopted. Thus the ITE and first official recognition of traffic engineering activities were simultaneously recorded.

Need for High Professional Standards

The automotive engineer is responsible for the vehicle that is an essential element in highway traffic. He studies its performance characteristics under conditions of actual use.The proving ground of large motor manufacturing agencies is an analytical laboratory in the larger field of public experience. This laboratory is devoted exclusively to performance characteristics and is staffed by automotive engineers.

The highway engineer has made remarkable studies in the *structural* performance of streets and roads—also an essential element in highway traffic. Throughout the history of hard-surfaced roads, it has been the engineer's responsibility to study performance characteristics of their structural properties. The highway engineer can take pride in his job of developing a great mileage of dependable all-weather surfaces. The hard-surfaced road without the motor vehicle would be of little use; and the motor vehicle without the hard-surfaced road would have much of its utility destroyed.

Something has gone wrong, then, when vehicles stand motionless in traffic snarls on the one hand, or destroy themselves and their cargo at high speeds on the other. There is, therefore, an engineering responsibility for the performance characteristics of vehicles and roads in combination with each other. Certainly, engineering responsibility does not stop with the creation of hard-surfaced roads and a dependable vehicle capable of high rates of speed. The nature of this engineering responsibility is referred to as *traffic engineering*.

There is but one logical approach to the problem of traffic operation—a factual approach and the application of engineering techniques. The engineering graduate with specialized training or practical experience is best equipped to cope with the intricate problems created by congestion and accidents that grow out of the limiting physical conditions of the roadway, the performance ability of vehicles and the highly variable psychological and emotional nature of the average driver.

Academic Qualifications

Some of the early traffic engineers matriculated from the school of hard knocks. A majority, however, were graduate engineers with years of experience in highway engineering. Initially, there was no specialized training available and no established qualifications to guide the Civil Service Commission in selecting candidates for traffic engineering positions. The training deficiency was met in 1927 by establishing Fellowships at Harvard University. At first only one or two fellowships were available for an academic year. Since 1936, with the exception of four war years, classes averaging twenty-five men

have received specialized training in traffic engineering at Harvard and (since 1938) at the Yale Bureau of Highway Traffic, where high academic requirements for entrance are rigidly enforced.

The traffic engineering course at Yale is designed to provide a broad foundation in techniques of traffic operation and to give the student increased skill and ability in the analysis of highway traffic problems. This course of graduate study and research is open to men who have received a degree in engineering from an accredited college.

Students in this graduate study make thorough inquiry into the following: (1) highway traffic characteristics dealing with such practical matters as the origins and destination of traffic flow, the volume of traffic movements, speed, accidents, congestion, parking, and the measurement and analysis of other highway conditions; (2) highway traffic regulations dealing with the elements of traffic regulation and the devices required to effect them; (3) traffic planning dealing with the many varied traffic planning problems, including both state and urban consideration; (4) traffic design dealing with the *functional* arrangements of traffic routes and parking facilities; and (5) traffic administration covering governmental and community organization and administration of traffic measures.

In 1948 came the first expansion of graduate training in the establishment of the Institute for Transportation and Traffic Engineering at the University of California. Graduate and undergraduate courses are being offered in traffic engineering. The intent is to make available trained engineers in sufficient number to man the expanded highway construction program, and to develop students in the field with broad outlook in the programs of modern transportation.

Among the first to institute undergraduate credit courses in traffic engineering, as part of the regular highway engineering curricula, were the Universities of Michigan and Illinois. This added elective in undergraduate training is becoming increasingly popular. Certain aspects of traffic operations are incorporated in the highway engineering course either by substitution of course content or by an additional hour of work with credit. Such work generally includes such items as the dynamics of vehicle movements, aspects of road uses and other traffic characteristics as well as operational standards of highway traffic design and traffic control devices. Universities now

offering traffic engineering undergraduate training include Michigan, Illinois, Purdue, Iowa State, Cornell, Syracuse, Oregon State, California, and Louisiana State.

The value of academic qualifications is evidenced by the high regard held by states, cities, the federal government, and private organizations for a traffic engineer who has received extensive specialized training. Each year the demand for graduate-trained traffic engineers exceeds the supply. The undergraduate trainee, if sufficiently inspired by his limited review of the profession, will either seek more extensive education in one of the graduate schools, or go directly into traffic engineering work.

From the academic point of view, the traffic engineer should be well founded in the fundamentals of engineering and should hold a scientific outlook in dealing with traffic problems. In addition, it is desirable that he have acquaintance with some of the social sciences including government, psychology, and economics. A familiarity with city and regional planning and an understanding of statistics is highly important.

Experience Requirements

In order to qualify for a Junior membership in the Institute of Traffic Engineers, the traffic engineer, in addition to a basic engineering degree, is required to have a full year of traffic engineering experience. For several years the Membership Committee and Board of Direction of the Institute, in considering applications for Junior membership, have recognized the time spent in graduate training as the equivalent of active practice of traffic engineering work.

Experience qualifications for various grades of city and state traffic engineers generally follow the pattern set by requirements for the various grades of membership in the Institute and ranges from one to five or more years of specialized experience in dealing with the technical aspects of highway traffic.

The Junior member must have had five years of active practice of engineering, of which one year must have been in traffic engineering. An Associate Member must be not less than twenty-five years old and must have had a total of eight years of engineering experience,

of which three years must have been in traffic engineering, including one year of responsible charge. Full membership requires a minimum age of 30, a total of ten years engineering experience, of which five years must have been in traffic engineering, including two years of responsible charge. For all grades, graduation from an approved engineering college is the equivalent of four years of engineering practice.

Duties of Traffic Engineers

Specifications[1] have been prepared illustrating the minimum requirements and duties of the state traffic engineer and the city traffic engineer for cities (1) over 500,000 population; (2) 100,000 to 500,000 population; and (3) under 100,000 population. As may be expected, the duties and minimum qualifications for the state traffic engineer and the city traffic engineer for cities over 500,000 population are identical, as they represent positions of comparable magnitude. For small cities, the only change noted is in age and experience requirements that allow the individual meeting associate member requirements of the Institute of Traffic Engineers to obtain these positions. These specifications show preference for men of specialized training in traffic engineering.

A comprehensive summarization of the general qualifications for a city traffic engineer (and one that could equally apply to states), based on the aforementioned specifications, is set forth below.

Qualifications for City Traffic Engineers

A. Minimum age limit twenty-five years.

B. Training. Graduation in engineering from an accredited college or equivalent experience. Specialized training in traffic engineering is preferred.

C. Experience. Candidates shall have been in the active practice of engineering for at least seven years. (Graduation in engineering shall be equivalent to four years of active practice.) They shall have had at least two years of active practice in traffic engineering. (Specialized training in traffic engineering shall be construed to be the equivalent of experience in traffic engineering for not more than one year.)

[1] Prepared by the 1947–48 ITE Committee on Functions of a Traffic Engineering Department, C. G. Stoneburner, Chairman, and available at headquarters of the Institute of Traffic Engineers, Strathcona Hall, New Haven 11, Connecticut.

Traffic engineering work shall mean the study and analysis of highway traffic characteristics, the study and practical application of highway traffic control measures including not only traffic regulation, driver and vehicle control, traffic codes and ordinances and rules of road use, but also the design, application, maintenance and operation of traffic control and design principles affecting traffic operation.

D. Duties. It shall be the duties of the city traffic engineer to determine the design, installation, operation, and maintenance of all traffic control devices. He shall have general supervision and control over the selection, design, fabrication, purchase, erection, maintenance and operation of all signs, signals, markings and devices, including channelization, islands and minor physical changes in the street system which guide, warn, direct, or control traffic. He shall conduct such engineering investigations of traffic conditions as may be required or permitted by any ordinance of this city or as may be requested by the Mayor, Board of Aldermen, Chief of Police, or Police Commission. He shall act in an advisory capacity with respect to any contemplated revisions of law relating to the control of traffic. He shall conduct engineering analyses of traffic accidents and devise methods for preventing such accidents. He shall transmit through line of command recommendations for necessary legislation to prevent and suppress traffic accidents and congestion. He shall have the power to call on any other departments of the city for assistance in the performance of his duties required herein. It shall be the study of such other departments to render such assistance as may be reasonably required. All questions as to what shall constitute a reasonable requirement are to be determined by the Mayor or Common Council. He shall receive and consider suggestions offered by citizens or officials within the scope of his powers. He shall have the custody and control of all property, books, records and equipment belonging to the office of the traffic engineer. He shall provide through the authorized purchasing agents of the city all materials and supplies for the use of his work.

He shall have such other powers and perform such other duties as are prescribed herein or in any other ordinance of this city relating to the control of traffic and shall have such other powers as may be necessary for the proper discharge of his duties.

General Duties Assigned City Traffic Engineer

"It shall be the general duty of the city traffic engineer to determine the installation and proper timing and maintenance of traffic control devices, to conduct engineering analyses of traffic accidents and to devise remedial measures, to conduct engineering investigation of traffic conditions and to co-

AUTHOR'S NOTE: From Model Traffic Ordinance prepared by National Conference on Street and Highway Safety, 1946, Section 28, Paragraph B.

operate with other city officials in the development of ways and means to improve traffic conditions, and to carry out the additional powers and duties imposed by ordinance of this city."

The preceding summary may be considered as the average qualifications for a city, or state traffic engineer and is often used as a guide in the preparation of ordinances establishing the position of traffic engineer. Typical examples of state and city ordinances showing qualifications and duties of the traffic engineer are contained in appendices 1-V.

Benefits of Traffic Engineering Services

Cities and states that ignore traffic engineering may rapidly find themselves becoming stagnant. Lack of up-to-date traffic planning and direction can cause property devaluation and decentralization. In such circumstances, congested downtown areas may be abandoned for breathing space in the suburbs or in rural areas. Merchants may be forced to move to outlying shopping centers. Why? Too often public officials disregard constructive criticism, technical condemnation and recommendation, and the public demand that requisite legislation be enacted to cope with the traffic problem.

Enlightened public opinion, through civic organization, is demanding and obtaining traffic engineering service to assist the enforcement and education groups. An excellent example of this approach was the poll of 15,000 registered voters conducted by Future Springfield (Mass.) Inc., a non-profit, fact-finding organization devoted to the development of the Springfield area. The results of the poll showed the citizens of Springfield overwhelmingly in favor of improvement in traffic conditions. Among the immediate results were the creation of a traffic commission, the establishment of a traffic engineering bureau, and the appointment of a traffic engineer with specialized training.

Some of the services provided by the traffic engineer include: (1) routing of through traffic; (2) location of grade separation structures; (3) location and design of safety islands; (4) advice in the determination of proper street widths and grades; (5) location of off-street parking facilities; (6) determination of one-way thoroughfares;

(7) location of no-parking streets and parking meters; (8) location for new traffic signals and signs; (9) location for no-turn regulations; (10) proper synchronization of traffic signals; (11) marking of streets to show traffic lanes, bus stops, turns, pedestrian crossings, loading zones, and no-parking areas; (12) location of taxi stands; (13) advice on changes in street lighting; (14) assistance in coordination of federal, state and city highway projects; (15) assistance in formulating new traffic regulations and elimination of antiquated ordinances; (16) studies for future planning to cope with increased traffic demands; (17) determining the feasibility of central freight terminals to eliminate heavy trucking in congested areas; (18) location of bus terminals; (19) studying the advisability and feasibility of revising zoning regulations to incorporate parking requirements; (21) coordination of existing departments charged with matters pertaining to traffic in engineering, planning, construction, installation, operation and regulation.

These services provide an insight into the many intricate problems confronting the traffic engineer, and conversely show benefits that may be derived from such services. Certainly these, and many other results of applied engineering techniques will rapidly lift states and communities out of the decadent class into the progressive and farsighted group.

Anticipated Future Needs

In developing the future needs of states, cities and the federal government for traffic engineering services, it becomes necessary to project present practices and requirements, correlate this number with training and replacement requirements, and "guess-timate" the growth and ultimate desirable needs.

It is conservatively estimated that there are approximately 700 men performing traffic engineering work of a professional or subprofessional quality with governmental or private organizations. Of this 700, it is estimated that at least 100 need further training or experience or both in order to qualify for full professional work leaving a net total of 600 men now qualified as traffic engineers ranging from junior to full member, as per qualifications adopted by the Institute of Traffic Engineers.

It is anticipated that a total of 1500 traffic engineers will be needed at the end of ten years, and since there are 600 now available, there is a total of approximately 1000 men to be enlisted, trained and given experience within this period. Events in the interim period may materially change this outlook. It may be concluded that, if the present pace is maintained, a desirable expansion in traffic engineering services will be realized by the year 1960. Only through strict adherence to the minimum academic and technical qualifications can this goal be achieved.

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